110 TESTED PLANS THAT INCREASED FACTORY PROFITS

H. P. DUTTON

~~Arnulf Heiberg~~

To Bryan,
At whom I am not angry -

110 TESTED PLANS THAT INCREASED FACTORY PROFITS

IDEAS SELECTED FROM THE PAGES OF
FACTORY *and* INDUSTRIAL MANAGEMENT
AS OF PARTICULAR VALUE IN PRACTICAL
FACTORY MANAGEMENT

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McGRAW-SHAW COMPANY
CHICAGO NEW YORK
1928

PRINTED IN THE UNITED STATES OF AMERICA

PREFACE

Don't sit down to read this book with the idea that it is a high-brow discussion of management's responsibility, or any elaborate theoretical analysis. It has no such pretensions.

Indeed, when you get right down to it, this isn't a book at all—at least, not in the accepted sense of the word. It cannot even claim to be a book on cost cutting. Rather, it is a set of "tools"—specific ideas of the sort managers use in their business of cutting costs.

Within its two covers you will find 110 tested plans that have worked in as many plants. Most of them are short items clipped from "Practical Ways to Cut Costs," a monthly feature of FACTORY *and* INDUSTRIAL MANAGEMENT, and chosen with a view to their applicability to a wide variety of plants.

For the most part, they are examples of management ingenuity contributed by readers, themselves busy plant managers. Perhaps you can lift two or three of these plans and use them just as they are. A mechanical handling system may have been designed to handle steel billets, but that's no reason why the same plan, or a modification of it won't work out in your plant when the product happens to be paper or cloth.

Here and there you will run across a longer article—a sample of the sort of thing you may expect to find each month in FACTORY *and* INDUSTRIAL MANAGEMENT.

Use this little book as you will. If, out of its 192 pages, you get a usable idea or two, it will have served the purpose intended by the editor.

H. P. D.

September, 1928.

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110 TESTED PLANS
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I

BUILDINGS AND YARD—
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I

BUILDINGS AND YARD—PLANT LAYOUT

BUILD YOUR PLANT WITH AN EYE TO THE FUTURE

WHEN a manufacturer starts to build a new plant, he looks into the future to picture, if possible, how he will be impressed by the layout of his works 10 or 20 years hence. And in this he is right, because the general scheme of a plant should not be one which merely takes care of present requirements, without concern for the future development of the industry.

Careful thought needs to be given to problems of expansion which will arise as the business grows, in this way making certain that the manufacture will always be carried out efficiently, no matter what stage of development has been arrived at in the construction of the plant. Industries are intended to succeed; success involves growth; and every well-arranged scheme will take into consideration the future extensions necessitated by such growth.

An ideal plant may be likened to an expanding library made up of sectional bookcases. As the library grows, new sections are added; it is always complete, yet always allows for the addition of further sections which, eventually, form one preconceived, coherent scheme. The same results can be obtained with the buildings of a manufacturing plant, provided due consideration is given to future developments and provided the buildings are erected to standardized dimen-

Courtesy Albert Kahn, Incorporated, Architects and Engineers, Detroit.

At the Ford assembly plant, Somerville, Massachusetts, floor areas are interchangeable units and may be altered as need for change arises.

Courtesy Albert Kahn, Incorporated, Architects and Engineers, Detroit.

The Studebaker Corporation's plant at South Bend, Indiana, is an excellent example of how well it pays to follow a prearranged building plan.

sions and details. The final desired effect can be procured with a minimum of inconvenience to the owner in the way of disorganization of his plant and at a cost which will not prove excessive.

Failure to make arrangements as herein outlined has, in many cases, been the causes of the poorly organized plants one finds only too often throughout the country. A manufacturer who builds only for the present later on finds it necessary to add wings or sections here and there as the occasion arises, and without a predetermined plan he eventually develops a group of buildings which bear no relation to each other. In the end he is possessed of a plant which is essentially disorganized, and it is needless to point out that such a plant cannot be operated under ideal conditions as regards supervision and economy of production.

It is a simple matter to obtain the desired result if the development of a plant is properly started. In selecting a site, one of the considerations should be the possibilities of expansion—the site should prove large enough for many years' growth. The architect should thereupon prepare preliminary designs showing, in outline, a grouping of buildings which will meet with the manufacturer's require-

ments as far as they can be foreseen for a period of many years. Obviously, the immediate construction of such a group of buildings would involve extravagant cost. Construction need only be started on such a portion of the scheme as will suffice for the immediate needs. With the growth of the industry, portions of the original plan can be constructed periodically, all the additions aiming at the final goal, as originally planned. With this method of development it matters little when and where construction ceases. The various buildings of the plant will then always be systematically arranged and will still permit of systematic extension. A commendable feature of this method of procedure lies in the fact that it entails no extra cost. In truth, economy will result, for this procedure eliminates the possibility of constructing buildings which might stunt the future growth of the industry or, on the other hand, which it might be necessary to remove in order to permit such growth to take place.

The method of development as above outlined refers principally to the horizontal growth of a plant. Factories can grow vertically as well as horizontally where multi-story buildings are concerned. When originally constructing such buildings it often proves advisable to lay foundations which are strong enough to support a number of floors greater than the number immediately warranted. For example, a two-story building could have foundations strong enough to support four extra floors. With the growth of the industry the extra floors can be added without disturbing the operations that are taking place on the lower floors.

It is true that this arrangement for the construction of multi-story buildings entails a slight extra initial investment, but this investment is certain to bear fruit. And the safety factor involved is worth much more than the risk taken in the extra investment.

Plant Number 6 of Dodge Brothers, Detroit, is a good example of this method. To meet present requirements, it was necessary to construct only a portion of the entire plan: the first unit, which consists of a building 1,962 feet long by 257 feet wide. The first unit was constructed merely for the assembly of cars. The entire development contemplates the eventual manufacture of parts to be assembled in the present unit. It allows for extending the building 120 feet to the west and 225 feet to the east. The total floor area of the present unit is about 502,000 square feet. The entire development contemplates 2,160,000 square feet.

With a preliminary design as herein described before him, the owner rests assured that as the necessity arises his plant will grow towards his prearranged scheme, and no matter when he stops building he will always have a systematic grouping of departments which will lend itself to economical production. In the end he will have a plant which is worthy of the efforts put into its development.

—One of a series of articles in 1927 *Factory* by Moritz Kahn of Albert Kahn, Incorporated, Detroit.

This gallery released valuable floor space for manufacturing purposes.

PROVIDING STORAGE SPACE AT LOW COST

A CERTAIN manufacturer was faced with the necessity for providing more floor space and had naturally thought of a new building. Investigation showed, however, that they had more room in the existing structure than they had realized, but that it was not being properly used.

One room, 30 feet long by 25 feet wide, was used for packing and for the storage of materials. It had a slanting roof, 30 feet high at the ridge, and was lighted on two sides, with solid brick on the other two. It was decided to build a gallery around the two blank sides of this room and to put light but bulky material on it, thus releasing

for manufacturing purposes the floor space that had been used for storage.

A gallery of structural steel with a wood floor was put up for less than $300. Of 5-foot width, this provided 250 square feet of additional floor space which, because of the head room, was the equivalent of a building 20 feet square. Wooden packing boxes of various sizes are now kept on the gallery instead of on the manufacturing floor. They are relatively light and can be piled without danger of overloading the gallery. Piles 20 feet high, extending to the dark corner under the roof, are now a matter of course. Since the gallery has a capacity of 2,000 boxes, stock can be made up in the most economical manner and at the most convenient time.

This inside construction does not affect the light or head room on the floor below. The advantage over the separate building lies in the much lower cost and in the greater accessibility of the stored stock.

AN UP-STAIRS IRON FOUNDRY

IF there is one business more than another that is close to the ground, literally and otherwise, it is that of the iron foundry. Invariably, the foundry is a one-story building with a dirt floor. Occasionally, the foundry may be extended under other floors of a multi-storied building when the molding floor outgrows its original size, but other departments of a plant object seriously to the dust, heat and smells which seep through. Hence foundries are generally the lowest and oldest buildings of a plant, set at a distance from the rest.

The illustration shows a foundry that has been in operation for several years on the fourth floor of a brick-and-concrete factory. It is altogether an unusual location but one that is entirely practical. The good lighting is evident and, from the perspective, the equally good ventilation may be imagined. Such a foundry is an attractive place to work in, as contrasted to the unpleasant conditions that obtain in so many plants.

A cupola of 3-ton capacity is installed and, due to the monitor roof, its entire length is inside the building, out of rusting elements. No pit-molding is done—hence the concrete floor offers no objections, while it has many advantages such as the positive leveling of flasks, better handling of sand, and a better and safer floor to walk on while carrying molten iron.

Contrast the good ventilation and light in this fourth-floor foundry with the unpleasant conditions that obtain in many iron foundries.

An elevator serves this floor, as well as the others, and the top-floor location thus offers no stumbling block to the handling of material. The splendid lighting is a direct aid in doing more and better work, with a consequent reduction in foundry losses.

A top-floor location is a logical one for founding. Heat and gases may rise without disturbing anyone. Good freight-elevator service takes away the materials-handling objection—and this service extends to the charging floor. The fact that fine tool making and pattern work is carried on in this building directly beneath this foundry proves that a good concrete floor effectually guards against the menace of an alleged dirty process carried on overhead.

READY-MIXED CONCRETE AT YOUR FACTORY DOOR

SINCE most manufacturing plants have no facilities for making concrete, a new development in the building world has already demonstrated its worth to industry. Central concrete-mixing plants which operate on a commercial basis have recently been established in three-score cities.

Among the early commercial mixing plants is that of the Sloss-Sheffield Steel and Iron Company of Birmingham, Alabama. Build-

ers with large and small requirements began to patronize this plant almost immediately. Another large commercial plant is the 1,000-cubic-yard plant of the Ready Mixed Concrete Company of Pittsburgh, which sends much of its output to nearby factories by motor-truck.

Ready-mixed concrete may be ordered from these plants much the same as coal is ordered from the coal dealer. Concrete may be purchased by the wheelbarrow load or in quantities large enough to build gigantic smoke-stacks. This new business of selling concrete "over the counter" is of untold value to the factory, for frequently concrete is needed for odd jobs, yet not in such quantities that would warrant the purchase of equipment. Furthermore, the rental of equipment or the hire of a contractor makes the cost higher than the patronage of the central mixing plant.

A decided advantage of the commercial plant is the ability to produce uniform concrete—concrete of the same strength and workability—day after day. In projects where great strength of concrete is required the builder may secure the correctly proportioned concrete at the commercial plant. The proportions of the concrete materials, sand, gravel or stone, cement, and water may be varied on short notice, thereby making it possible for the central plant to produce material for a number of different jobs in the same day.

A STORAGE METHOD THAT SAVED A NEW BUILDING

WHEN the Tinnerman Stove Company, Cleveland, Ohio, was faced with the necessity of securing more space for the storage of finished goods, their first consideration was that of erecting an addition to their plant.

In addition to an estimated cost of $25,000 for a new building adequate for their needs, there was the problem of handling the stoves from the packing department to storage, and rehandling them again for shipment. The handling costs which would result were estimated at about $10,000.

As an unusual alternative, it was determined to install overhead storage space on roller conveyors. The overhead installation possessed the advantages of utilization of space in the existing building, elimination of much of the handling which an addition to the building would have made necessary, and a saving of approximately $20,000 in building costs.

The conveyors are suspended from the ceiling, and lifts at both ends handle the stoves to and from storage. A specially designed portable section, mounted on a traveling carriage, simplifies transfers. One man can easily distribute all the stoves coming into storage, and only in rush season is it necessary for him to have a helper to take care of outgoing shipments.

ONE WAY TO KEEP PASSAGEWAYS CLEAR

TO keep factory passageways clear in most establishments means a lot of real hard work for management and causes many an outburst of profanity, for it is human nature to dump parts and materials in the most attractive looking places. All of which can be avoided, since there are ways and means of defining roads throughout the plant and keeping them clear. And clear passageways play their part in maintaining production schedules.

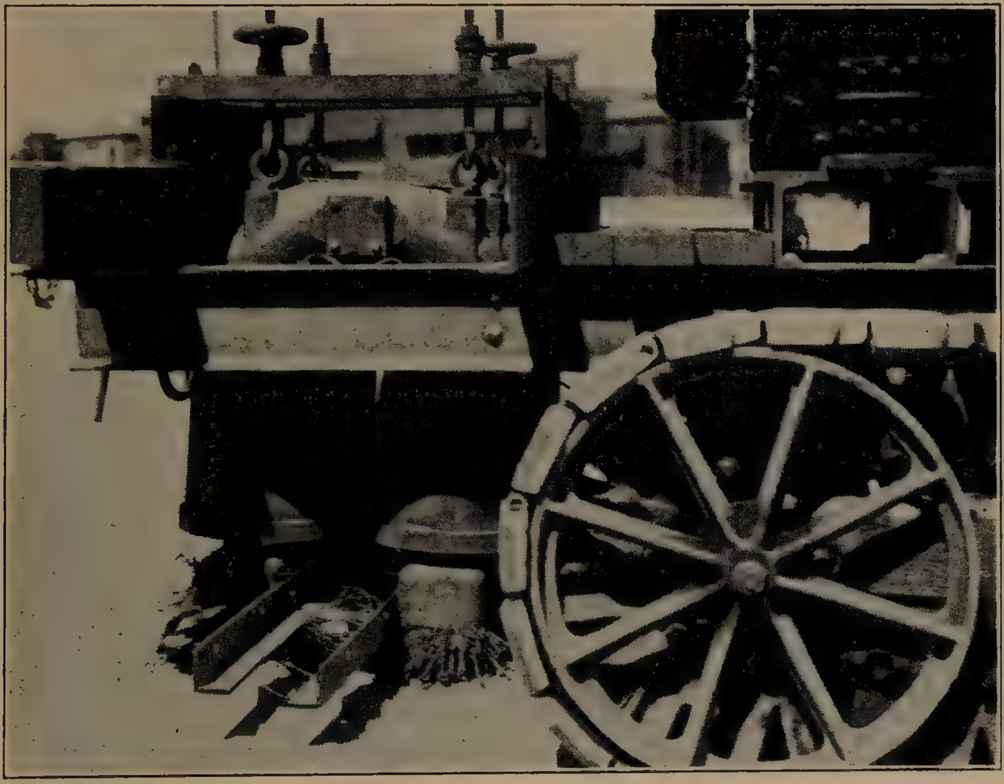
White lines painted on the floor are used in some plants with a measure of success, but unfortunately white paint, or any paint that can be seen readily, soon becomes obliterated and necessitates frequent maintenance. A better way has been found at the Continental Can Company, where bright monel metal traffic markers—so often seen on the busier streets of large cities—are used to mark passageways in the plant.

These markers have a soft malleable iron base sheathed in a top made of heavy gage monel metal thick enough to wear for years. When installed, they present a series of platinum-like, rust-proof, corrosion-resistant surfaces which are as strong as steel, and which will preserve their first appearance indefinitely. Since the markers are slightly dome-shaped, they reflect light in all directions—a distinct advantage where passageways are habitually dark.

GOOD HOUSEKEEPING IN YARDS PAYS DIVIDENDS

NAILS and scrap iron which litter the yards of many industrial plants constitute a serious menace to automobile and truck tires, and offer at the same time an excellent chance of injuries to workmen. How these possibilities may be reduced to the minimum is illustrated by the novel installation of a huge magnet at the mines of the Chile Exploration Company at Chuquicamata. The magnet is suspended from a trailer a few inches above the road, and mounted on the same trailer is a 48-cell battery which energizes the

magnet as the trailer is drawn over the road by a tractor. As may be seen from the photograph, a considerable amount of metal is picked up in the course of a trip. The device, in use every day, is estimated to have paid for itself many times over in the saving of punctured tires and injuries to workmen.



A magnet suspended from a tractor-drawn trailer is used at the mines of the Chile Exploration Company to pick up nails and scrap iron.

II

BUILDING EQUIPMENT AND MAINTENANCE

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II

BUILDING EQUIPMENT AND MAINTENANCE

SPRAY PAINTING WHILE PRODUCTION GOES ON

AN objection often heard against painting a factory by the spray method is a by-product of misplaced paint which may result. By the exercise of a little ingenuity this difficulty was overcome in the press-room of the Multi-Colortype Company of Cincinnati, which contains a great number of machines in constant operation. Neither the machines nor the work in process could be allowed to be soiled or contaminated by any paint or spray-dust. Yet the advantage of getting the painting done in the least possible time made spraying desirable. This was accomplished by confining the work to a curtained-off section.

This room is 240 feet long, 100 feet wide, with a 20-foot ceiling, half flat and half saw-tooth, and cut into bays by beams placed 20 feet apart each way. Three of these bays, making a space 20 by 60 feet, were partitioned off at a time by drop-cloths hung from ceiling to floor, providing a tight compartment within which the

Drop-cloths hung from ceiling to floor made tight compartments within which workmen could spray without interfering with production.

men could spray without interfering with the rest of the machines outside the curtains.

The total area coated was 44,000 square feet, and 475 labor-hours were consumed, two sprayers being employed, and two helpers for covering and rigging the drop-cloths. Each sprayer averaged nearly 200 square feet an hour, and the work was completed in less than 15 days with no appreciable interference with production, whereas it was estimated that with an equal amount of hand-labor it would have required from 45 to 60 days to complete the job.

NO NEED FOR DAMAGED WALLS

DAMAGE to building walls around shipping doorways has increased very rapidly with the advent of motor trucking instead of lighter and less powerful horse-drawn vehicles.

Oftentimes the abuse that walls have received has gone unheeded for a long period of time, or until it has been necessary to make repairs for the security of walls or door-frames.

When these repairs were made—usually a major operation—the value of some sort of adequate protection has been provided.

The illustration shows a wall protector that was put up at the plant of Edwards Brothers, Ann Arbor, Michigan, at the time a

A buffer of dressed lumber is a simple and economical way of preventing damage to brick walls around the shipping doorways of manufacturing plants.

new building was erected—the owners having had experience with the practice of "locking the stable after the horse was stolen" in patching up walls damaged by trucks backing into them.

This protector is built of three uprights of dressed timber. These were attached by bolts to the wall as the concrete and tile was built up. In this way, the cost was lowest and the danger of excessive damage from drilling holes later was avoided.

The two horizontal pieces were attached at a later date but before the building was in use. One plank is at the height of truck platforms and is broad enough to meet the variations that occur with different trucks and loadings. The other plank is lower down, where it will catch wheels and hubs that might strike, under various movements or with trucks of special construction.

Should this simple wall protector be damaged, it is an easy matter to unbolt and replace the horizontal pieces.

UNIT HEATERS SPELL PLANT COMFORT

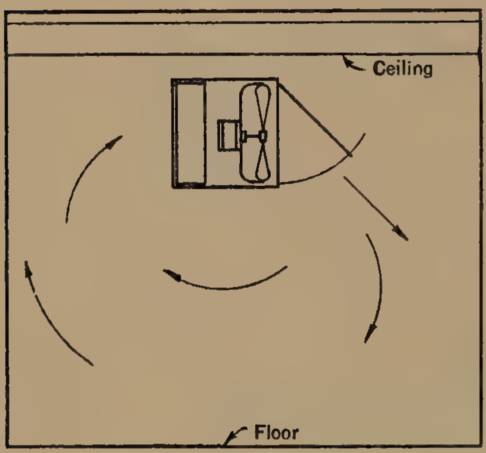
UNIT heaters are not a new departure in factory heating. They have, in fact, been manufactured for many years, but until quite recently the only heating coils available were heavy cast-iron or steel affairs which met with more or less opposition. In most instances the unit was too heavy to suspend from the truss work or roof, and therefore had to rest on the floor, taking up valuable floor space. But since the introduction of copper coils, unit heaters have become lighter, more compact, and more efficient. As a result, there is an increasing demand for this type of heating system.

The reasons for using unit heaters are many. In most instances the initial cost is less than that of direct radiation, the exact amount varying with the particular conditions surrounding each installation. Again, a saving can be made in fuel during the night, as a building may be quickly brought up to a comfortable temperature in the morning by means of the unit heater. With direct radiation it is necessary for the boiler-room force to fire almost continually through the night to obtain comfortable working conditions by opening time in the morning.

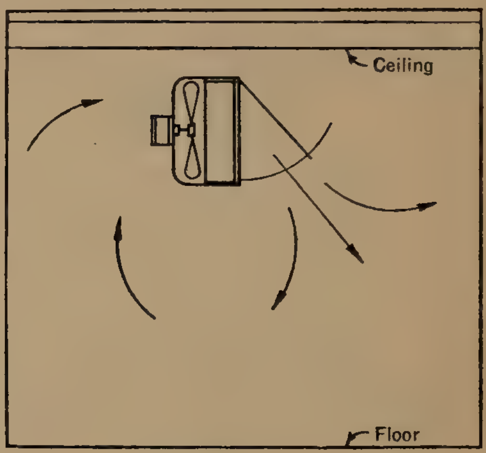
Furthermore, radiators located around the wall interfere with the best utilization of available floor space and are in locations where they are easily bumped into and broken. Unit heaters maintain a more uniform temperature, due to the circulation of warm air, and

this uniform temperature may be further controlled within certain predetermined limits by using simple thermostats which turn the fans off and on.

Unit heaters are also very useful in introducing fresh air from the outside and heating it considerably above the room temperature. Wherever gassy conditions are found in garages or manufacturing plants, the supplying of fresh air is very essential. If the air is merely exhausted from the building, then the only means of introducing air to replace that which the fan is exhausting is through the cracks around the windows and doors, which causes uncomfortable drafts throughout the building. This condition can be overcome by introducing tempered air with unit heaters.



Draw-through type.



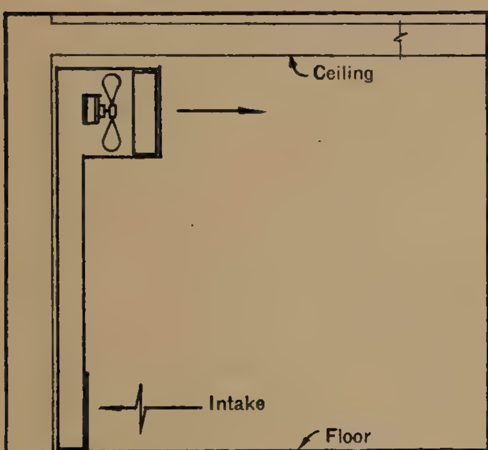
Blow-through type.

There are now many types of unit heaters on the market. And, as shown in the accompanying figures, each type has certain distinctive points that must be considered.

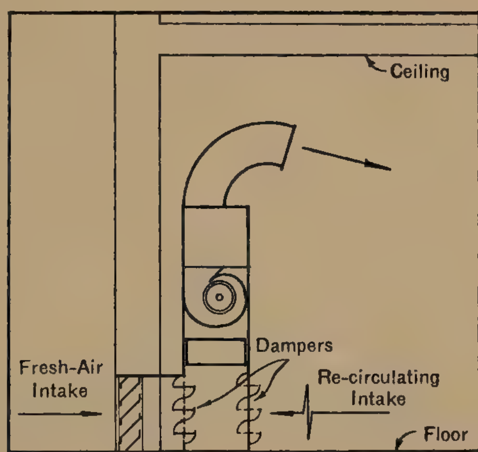
First, unit heaters are divided into two distinct classes—those that use the centrifugal blower-type fan and those that use the propeller-type fan.

Blower-type units are used for the purpose of blowing the heated air greater distances, and because of their ability to develop high velocity as in buildings with high roofs and high monitor construction. They are also useful where, for some reason, the engineer wants to make a simple layout using one or two units to take care of a large space. This type of heater is frequently mounted on the floor instead of overhead.

Mounting the unit on the floor and taking the air from the floor causes a big air movement at that point for a considerable radius around the heater. Some engineers feel that taking the air at the floor and discharging it at a high velocity horizontally produces better results than having the unit mounted overhead. This, however, seems to be a matter of opinion, as both methods give excellent results when properly installed. Mounting the unit overhead exhausts the air from the upper air strata, where it is a few degrees warmer than at the floor, and discharges it to the floor, mixing it with the breathing line. This method eliminates the drafty condition which sometimes exists on the floor near the heater, and also does not take up valuable floor space.



Blow-through type—with floor-line intake.



Floor type of blower unit. Draw-through type shown.

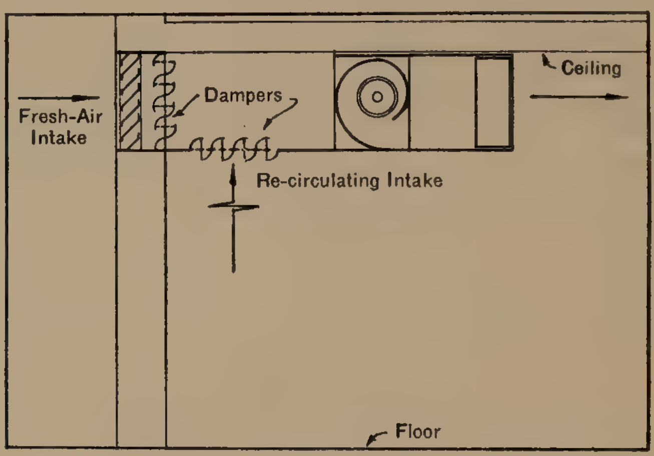
Where the air is to be introduced from the outside, the blower-type unit in most cases requires a smaller intake area, or grille, due to the high velocity used, and thus fits in better on some installations of this kind. The disk-type heaters can also be arranged to introduce outside air, the only difference being that larger intake grills are necessary.

The propeller-type unit heater is used because it handles large volumes of air at low electrical power consumption. These heaters are usually used with the idea of churning up large volumes of air raised to 60 or 70 degrees above the room temperature and allowing it to mix with the cooler air, gradually forming a uniform mixture.

There are two distinct classes of propeller-type heaters—those

that place the fan behind the heating coil and blow the air through, and those that place the fan in front of the heating coil and draw the air through. In the blow-through unit, the fan is very close to the heating coil and blows the air through at a high velocity, and the resistance of the heating coil retards the air velocity. The draw-through-type heater draws the air over the heating coil at a low velocity and discharges the air at the full velocity of the fan. The re-circulating duct to the floor picks up the cold air from the floor and heats it.

A building may be heated with a large number of small propeller-fan units or a fewer number of larger blower or propeller-fan units. Each layout will heat the building, if properly installed, and the next



Blower unit with air intake, ceiling type. Draw-through type shown.

important thing to consider is maintenance. A certain building can be heated successfully with 5 or 6 small units, with two large propeller-fan heaters or two large blower-type heaters. On the one system there would be 5 or 6 small single-phase motors to look after. With 5 or 6 installations, more piping, valves, and fittings are necessary. With two large propeller and blower units, the motors would usually be 3-phase ball-bearing. The piping would be a simple steam main and return along one side of the building. This layout would be far more practical and would accomplish the same results.

In extremely high buildings, the blower type has apparently been more successful than the propeller-type heaters because of the high velocity which is characteristic of this type of heater. In high buildings, it is necessary to blow the heat to the floor zone and hold

Unit heaters cut the time required to bring buildings up to comfortable working temperatures, making it unnecessary to fire continually through the night.

it there for greater distances before it goes up to the top of the building. The large propeller-fan units have also been used on this type of building but with a lesser degree of success than the blower type. The smaller-type units are useful only in taking care of roof losses and do not have sufficient velocity to drive the heated air from the top of the building to the floor.

Large blower-type heaters are therefore recommended for use in high buildings or where the air must be blown long distances or across buildings with high monitors. In all saw-tooth buildings of average height, the blower type or the large draw-through propeller type with an adjustable deflector gives good results.

In buildings with low ceilings, the draw-through propeller-type fan with deflector is very efficient because of its low power consumption and ability to deflect the air to the floor at the proper angle. To obtain the best results, the deflector should be adjustable, to take into consideration the height that the heater is placed above the floor. Such heaters have been used successfully as high as 14 feet off the floor, but a height of 7 to 10 feet is recommended providing it fits in with the purpose for which the building is intended. Overhead units should be used in cases where a drafty condition on the floor would be objectionable, and where the owner wants every square foot of floor space available for manufacturing purposes.

Small blow-through-type unit heaters are useful in buildings which are cut up by many partitions, and where proper distribution cannot be obtained with larger units. The electrical power con-

sumption of the system must always be taken into consideration. The best way to keep this item at a minimum is to distribute as far as possible by means of the steam main.

Each heating installation is a problem, which should be handled separately to get the best results. There is no economy in using undersized heaters, piping, or boilers.

Unit heaters are like everything else; there have been good and bad installations, but in general they have been highly successful. Buildings have been heated which would have been impossible to heat with direct radiation, and practically every company that has used unit heaters will have nothing else. They do not necessarily provide the answer to all the knotty problems that come up in connection with factory heating and ventilation, for there are conceivable instances where direct radiation still provides the best method of heating. But at least it can be said that when properly chosen and installed unit heaters supply a means of heating factories comfortably at a minimum of initial cost and operating expense.

—By H. E. Ziel, Albert Kahn, Incorporated, Detroit.

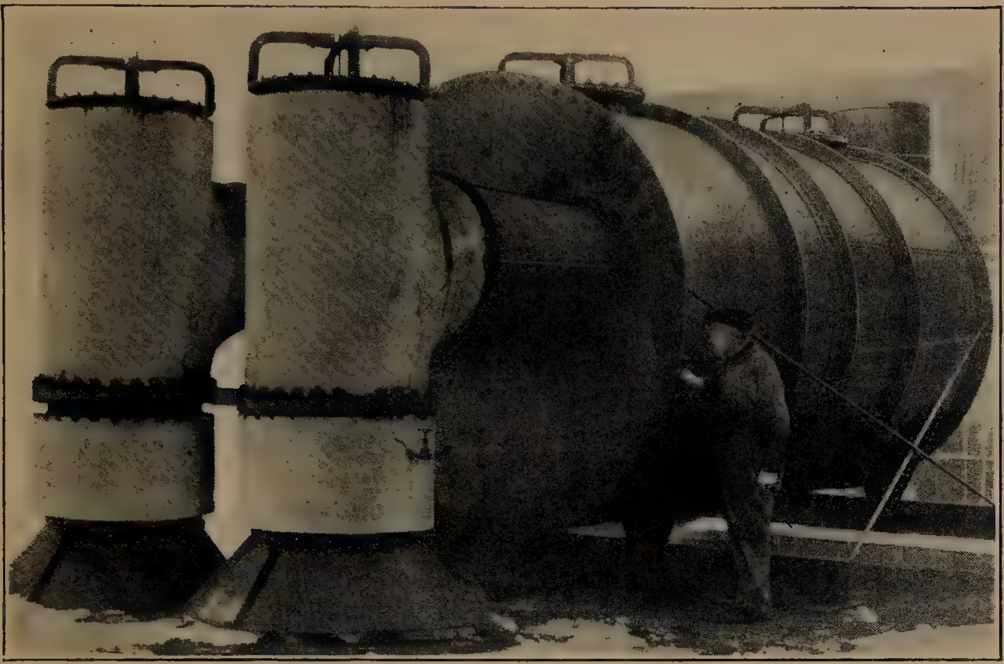
TRAPPING THE NOISE OUT OF SOUND WAVES

THE industrial silencer is a development of the gun silencer and may be applied successfully to gas, air, or steam exhausts and suctions to trap out the offensive sound waves and to quiet the explosive noises.

If baffles are used to quiet exhausts, the gas speed is cut short as the gases burst forth. The gases have little play, and high back-pressure results. The inertia effect of mass flow cannot develop, and the benefits of the pulling or sucking effect of the long stack are lost.

The silencer, on the other hand, contains virtually a long stack with a passageway so coiled that it fits into a short space. The longer the passageway the greater the mass of gas it holds, and the greater the mass of gas the greater the pulling capacity or "stack effect." The silencer therefore traps out the noise without materially impeding the free escape of gases. The latter progress toward the outlet through a channel which offers no restriction, turbulence, or baffling.

A 30-inch industrial silencer is installed at the Highland Park plant of the Ford Motor Company, where it is used to quiet the



This 30-inch silencer at the Highland Park plant of the Ford Motor Company quiets the exhaust from the 2,000 h-p. side of a 5,000 h-p. gas-steam engine.

exhaust from the 2,000 horse-power side of a 5,000 horse-power gas-steam engine. The gas pulse passes first into a comparatively small expansion chamber which smooths delivery in much the same way as the air chamber on a reciprocating pump, and further provides a place where solid or liquid matter in the gases may deposit for easy removal.

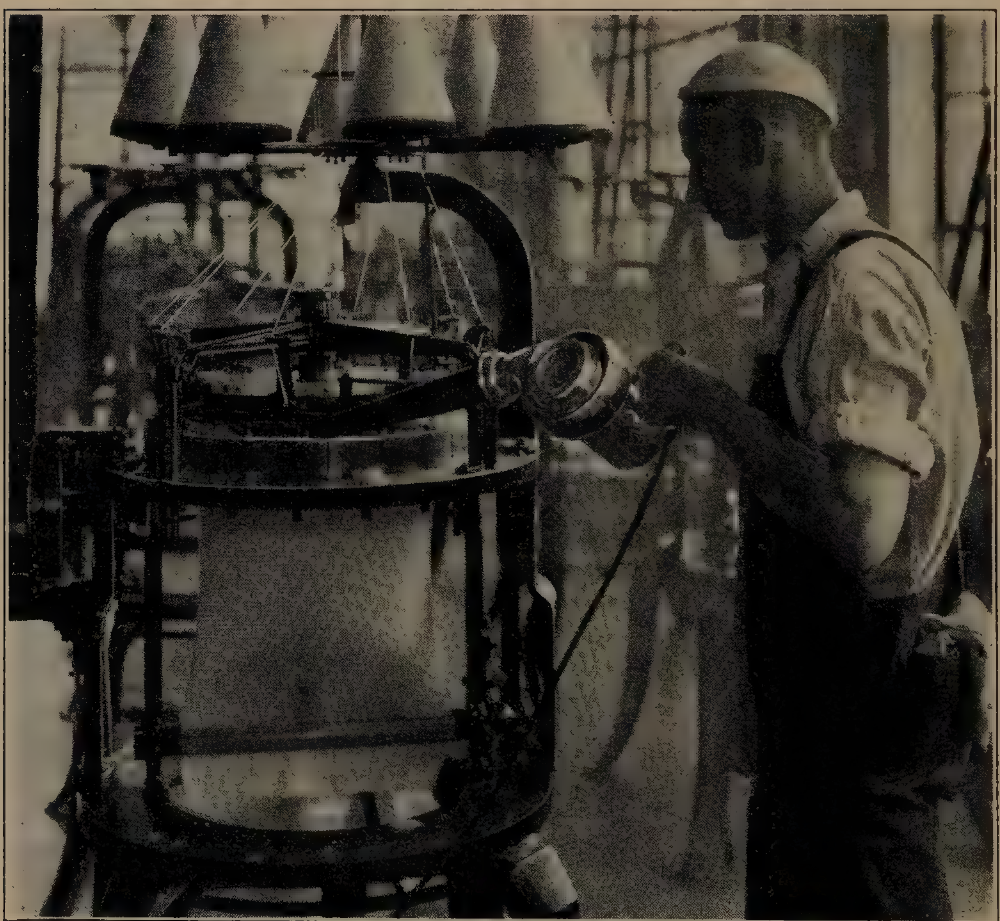
The silencing unit proper, into which the gases then pass, traps out the noise wave by utilizing repeated reflection to dissipate the energy of the wave. It is built up of sections which, when assembled, form parallel spiral passageways. The gases enter inlets staggered at the periphery, are split into spiral streams which unite again at the center, and pass on smoothly and silently through the outlet in the same direction in which they enter.

The spirals offer a long, smooth, and constantly but gently curving conductor in which the very desirable "stack effect" is present to a high degree. They also serve as a noise trap by compelling a great many reflections of the sound wave from a poor reflector. When the wave is finally liberated to atmosphere, enough energy has been abstracted by the silencing unit to rob it of its offensive qualities.

FEWER BREAKDOWNS WHEN YOU BLOW THE DUST AWAY

THE importance of keeping machines free from dirt and dust can hardly be overemphasized. And usually the expense of maintaining them in first-class shape more than pays for itself through insuring continuous production by anticipating costly breakdowns.

In knitting mills, for instance, the lint and dust caused by the friction on knitting machines gather in the working parts and soon clog the machines to a point where they are unable to function properly. The accompanying photograph shows how at low cost one company insures continuity of operation by using a portable-electric blower to keep the machines clean and free from foreign matter of any sort.



Portable electric blowers keep knitting machines free from lint and dust, thus insuring continuous production by anticipating costly breakdowns.

Costly breakdowns are anticipated in this plant by the simple expedient of making each man responsible for the proper lubrication of his own machine.

THIS PLAN KEEPS MACHINES RUNNING

MAKING the machine men responsible for their machines—impressing their responsibility upon them—that is the way in which machines are kept up to top notch all the time in the plant of the Weber Show Case and Fixture Company of Los Angeles.

Notice the sign in the middle of the machine floor in the illustration. It reads: "NOTICE—Every machine man will be held responsible for his machine. Oil and grease machine every day before starting. This will save 75% repair bills. Per Paul Weber, Foreman."

This method of keeping machines in good running order is simple and efficient. A few moments each day suffice. Maintenance costs are cut to the bare minimum, and there is seldom need for major repairs so often caused by faulty lubrication.

A CONVEYOR CHAIN SLIDE THAT WON'T WEAR OUT

A MANUFACTURER was experiencing difficulty and delays to operations in keeping in order a slide or run for the returning portion of a heavy endless conveyor chain. Slides constructed of wood, even when faced with metal strips, frequently became damaged or worn. The trouble was overcome by building a slide made of two runs or lines of steel rails that were worn to a condition unsafe for continued use in track service. The regular angle bars or rail couplings were discarded, and the sections of rail were coupled

together with pieces of flat iron, narrow enough to pass wholly into the grooves in the sides of the rail. It was therefore possible to place the two lines with the edges of the rail bases in contact, which the regular couplings would not permit because their lower edges projected slightly beyond the edges of the rail flanges.

The rails were spiked to the center of cross-sills supporting the conveyor studding. In this position there is just enough space be-

Steel rails form a durable slide for the returning portion of a conveyor chain.

tween the inner edges of the rails to allow the free passage of the lower edges of the vertical links of the chain, and in this manner they are kept upright, held straight, and the chain prevented from twisting easily. The horizontal links run with their sides resting on the face of the rails. The lags also slide along the face of the rails, and the angled prongs of the lags extend down beside the rails, thus preventing the chain from getting entirely off the run through side pressure.

The slide is very durable and substantial, has required little or no attention, and will last indefinitely. There is no danger of the lags hanging behind the ends of the rails and causing the slide to be wrecked, which often occurred with the wood runs and metal facings.

ALUMINUM PAINT BRIGHTENS UNSIGHTLY STACKS

THE Robert Gair Company, at its Piermont, New York, plant, had experienced considerable difficulty in finding a paint that would adhere properly to the smoke-stacks shown in the figure. After an exhaustive series of tests it was found that aluminum paint wore much better than any other paint used.

Aside from the matter of painting economy, the aluminum-painted stacks attract much favorable comment due to the eye-value of their silvery color, and doubtless return something in the way of publicity.

Quite apart from the question of economy, The Robert Gair Company has found that aluminum-painted smoke-stacks attract much favorable comment.

Air-separators do away with the annoyance caused by water in compressed-air lines, and insure clean, dry air to tools in the assembly line.

SEPARATORS BANISH AIR-LINE TROUBLES

WHEREVER compressed-air is used, water in air-lines may be the source of much trouble. Sometimes it develops a water-hammer, comes through the tool in slugs, and causes tools to freeze up. Or again it washes the lubrication out of the bearings, thereby causing excessive wear with consequently high repair bills.

This trouble develops because the air cools and condenses as it approaches the outlet. How the condition may be remedied is illustrated in the accompanying photograph which shows air-separators installed in the compressed-air lines at the Buffalo plant of Chevrolet Motor Company. The separators remove all water as well as heavy particles by centrifugal force at the air connection, and insure clean, dry air to tools in the assembly line.

Air-separators not only do away with the annoyance of water dripping on the work, but also help to keep tools in condition, thus cutting maintenance costs and adding life to the equipment.

SPRAY BOOTHS DESIGNED TO COMBAT FIRE HAZARDS

EVEN greater advantages than anticipated have come from the design and use of some novel lacquer spray booths at the plant of Charles P. Limbert Company, Holland, Michigan. Essentially what has been done is that the spray booths have been located outside of the workrooms proper and built through the wall to the outside of the building.

A couple of windows and a portion of the brick wall were cut out and two I-beams placed across the top, three smaller I-beams anchored into the wall below, supported with channel-iron brackets anchored through the wall on the floor below. The necessary framework of wood was then built up, and the ceiling joists securely anchored in the upper wall.

All necessary wiring was placed in standard enameled conduit and the sprinkler pipes were installed according to the fire underwriters' suggestions. The inside of the booths were sheathed with smooth sheet iron, while the entire outside was covered with heavy galvanized iron.

One of the most important features is not evident from a casual glance. This is that the ceilings of the booths are at least two feet above the bottom of the I-beam which forms the top of the opening into the room. This arrangement forms a "flame pocket," protected by several sprinkler heads.

The motors which drive the exhaust fans are contained in waterproof housings over the suction outlets.

Another interesting feature of considerable importance is that the floors of the booths are about four inches below the factory floor, and there is a water drain on either side. Thus, in case of fire, if the booth is flooded, the water drains outside instead of into the factory itself. To retain the advantages of the sunken floor to combat the fire and water hazard, and at the same time not to interfere with production, two movable sections of floor are placed over the inside half of the booth so that this portion of the floor is flush with the factory floor and with the turntable in its lowered position.

Projecting from the exterior factory walls as these booths do, they

are particularly accessible from three sides, top and bottom by the firemen. And smoke would be less of a hindrance.

Besides the reduced fire hazard resulting from this arrangement, there is a considerable gain in floor space. The fire hazard will be still further reduced when the installation of roller fire doors above the entrance to the booths has been completed.

STEEL FLOORS ARE EASILY CLEANED

IT is inevitable that around well-lubricated machinery some oil will get on the floor. And when this happens, even frequent wiping up under an excellent maintenance routine will not prevent the oil from soaking into wooden floors and constituting a considerable fire hazard.

This situation is obviated at the Hawthorne plant of the Western Electric Company by laying on top of the wooden floor a floor of sheet steel. Since this steel floor is fabricated from strips about 18 inches wide it may be readily "tailored" to fit spaces of any shape or floor irregularities of any sort. And because the strips are soldered together they are oil tight.

PLAYING THE GAME OF PLANT HOUSEKEEPING

THE interdepartment competition idea received a new application recently in the plant of the General Fireproofing Company of Youngstown, Ohio. The company wanted to find a method of stimulating the men in the 30 departments to keep scrap cleaned up, tools in their places, and to maintain shipshape conditions generally.

Orders bearing on the situation were obeyed perfunctorily but without enthusiasm, until the whole project was turned into a game. The entire factory was divided into three competing groups.

Each department is rated on a weekly inspection. Within each of the three groups, each department competes for a shield and a small cash prize. A star emblem, with a slightly larger cash accompaniment, goes to the best department in the factory. The cash in each case is sufficient to provide cigars or cigarets all round.

While the game was not planned directly as a safety measure, one of its by-products has been a cutting down of time lost from accidents. Greater care in handling materials and scrap has reduced the accident rate perceptibly, though in the manufacture of steel office furniture the danger of accidents is not great.

On the first inspection trip the power department looked immaculate. But one of the inspectors opened a locker, another pulled open a drawer. One peeped into a closet where tools were kept. The emblem did not hang there that month. But the men were put on their mettle and now they have the star which marks their department one of the best in the factory. And they all smoke cigars when they punch the clock at night.

UTILIZING A WASTE PRODUCT FOR PAINTING

EXTERIOR and interior walls of the Colonie shops of the Delaware and Hudson Railroad are whitewashed with slacked lime which is precipitated in the process of generating acetylene from calcium carbide. The acetylene is generated for oxy-acetylene welding.

III

POWER GENERATION AND TRANSMISSION

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III

POWER GENERATION AND TRANSMISSION

HOW MUCH DOES YOUR POWER DOLLAR BUY?

ONE make of automobile is worth twice as much as another, though it carries only the same number of passengers, at the same rate of speed. The difference lies in quality. Cars, like most other merchandise, have to be classified according to quality for purposes of fair comparison in cost.

The commodities of heat and energy, however, are independent of quality variation. A British thermal unit is a British thermal unit, or a B.t.u. for short; a kilowatt-hour is a kw-hr. And that's that.

This is a fortunate and agreeable fact for ultimate consumers. For here at least is a market in which you can do your buying on a clean basis of dollar competition, where price is price and units are units. The little units of energy and heat are stable and fixed in value.

But some shrewd or lucky buyers get more for their dollars, a great deal more than others.

Some consumers buy their heat and energy in crude form in bulk. By more or less skilful home processing they transform them into the useful and applicable forms of power, light, and heat for their factory consumption.

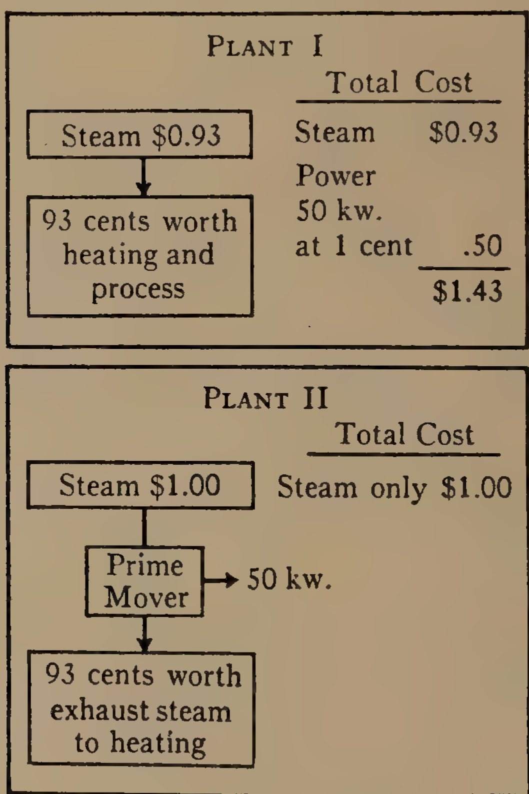
Others buy one or both products in finished form from manufacturers who specialize in these fields, generally producing this power in large quantities with the object of low unit cost with a good leeway for expense of delivery and profit.

While we can classify power consumers into two groups, those who make and those who buy, we can by no means pick either group as wise or foolish, shrewd or extravagant.

The purchase of the cheapest waterpower for some factory plants would be wild extravagance; while in others a power contract at high rates would serve economy best. Consider the two small diagrams which follow.

Consider purchased power to be available at the very low cost of

1 cent per kw-hr. and that the factory in question can make steam for 50 cents a thousand pounds—a fair figure. Consider a factory then needing, say, 93 cents' worth of steam for heating and process and a steady power demand of 50 kw. It may buy this power or make it, but it must provide also the 93 cents' worth of steam. Diagram 1 shows the results when buying the power at 1 cent and Diagram 2 when making the power with a prime mover, the exhaust of which supplies the heating and process requirements.



The same results are obtained in both plants as to power and heat supplied. In Plant 1 the cost of power and fuel are respectively 50 cents and 93 cents or a total of $1.43.

In Plant 2 the cost of power and fuel is a total of $1.

Had power cost 2 cents per kw-hr., the total cost in Plant 1 would have been $1.93 against $1 as before in Plant 2.

Now, if our factory needs no steam whatever, a study of all conditions and costs might show that the power could be purchased

In the older plants the coal consumption per kw-hr. generated often runs as high as six pounds. Here is a typical out-of-date factory boiler room.

more cheaply than it could be made. If we have a large and steady demand, it might pay to make it.

While it is very interesting to investigate the public service companies' cost of producing and delivering energy, after all, what the consumer is primarily interested in is the money he actually has to pay to get it: the price to him and not the cost to the central station company. But before proceeding, as a matter of general information, it is interesting to know that the capital invested in central power plants and their transmission systems has been computed to be about double the cost of installing a kw. of capacity in an industrial plant, thus incurring double the fixed charges per kw.

The current delivered at the plants of the consumers is only 80.5% of the power generated in the central station, due to transmission losses. Profit on the business must also be added to the cost. These are big handicaps which the public service companies must compensate by extreme measures of economy in the application of modern methods of generation on a large scale for minimum unit costs.

For these reasons the central station plant must naturally be the

leader in developing and applying the most advanced ideas in power generation. And it follows that the privately owned industrial plant usually awaits the experience of the central station instead of introducing the newest and unproved equipment.

This has been notably true in the development of the steam-turbine, higher boiler pressures, superheated steam, pulverized fuel, modern furnace construction, higher boiler ratings, air preheaters, combustion-control equipment, feed-water treatment, operating methods, and the application of plant records.

Even in the field of public service, where truly marvelous records of efficiency have been made, there remain, nevertheless, plants still in use where the efficiency is very poor. These are, of course, the older plants in which the coal consumption per kw-hr. generated runs as high as 4 to 6 pounds, as contrasted to an equivalent of about 1 pound, in the very latest and best. This is a wide range of variation and leaves plenty of scope for improvement in bringing up the average.

Is it not quite natural then that in the industrial plants, which are followers of these leaders, there should exist even more widespread and at least equally divergent efficiencies in the application of power and heat? This is decidedly the case, more especially so since the central steam plant in its latest stage has already realized an efficiency very close to the possible ultimate. On the other hand, the industrial plant is still capable of enormous improvement before that ultimate point is even approached. The industrial plant has the further weighty advantage in so many instances of being able to utilize exhaust steam at any needed pressure, thus making its power as a virtual by-product of the heating steam.

According to the United States Census of Manufacturers' Report just issued, during the two years 1924 and 1925 the rating of motors run by privately generated energy increased by 16.3%, while the rating of motors run by purchased energy increased 19%. Perhaps the gain in purchased power would have been less than that of privately generated power if industrial owners had applied modern engineering practice to their own power plants.

Of course it is natural to prefer to buy power rather than to maintain a power plant of your own. It is less trouble and good business—if it does not cost too much. How can you know whether it costs too much? By knowing the cost of making your own heat

and power combined when done in the best way; and then the combined cost of buying the power and making the heat. In addition to the "knowing," that little phrase "when done in the best way" contains some real food for thought.

In view of the recent great improvements in power generation, largely made available to industrial plants by the practical experimentation of the central power stations with new equipment, would it not be advantageous to check up your own power and heating operations to find out whether they are being "done in the best way"?

Is it not a good time now to call a conference for the good of the business? Call in your own plant engineer and get his ideas. Call in his friend, and yours, the steam and power specialist, and make a real study of your own situation. Perhaps you can save money by buying your power. Perhaps you can save more by bringing your own plant equipment and methods of heat and power application up to date. Who knows which answer is right? Certainly not I, without a thorough knowledge of your own particular power and

It is natural to prefer to buy power than to maintain a power plant. It is less trouble and good business—if it does not cost too much.

heat requirements, plant equipment, and condition and unit costs of fuel, labor, and supplies.

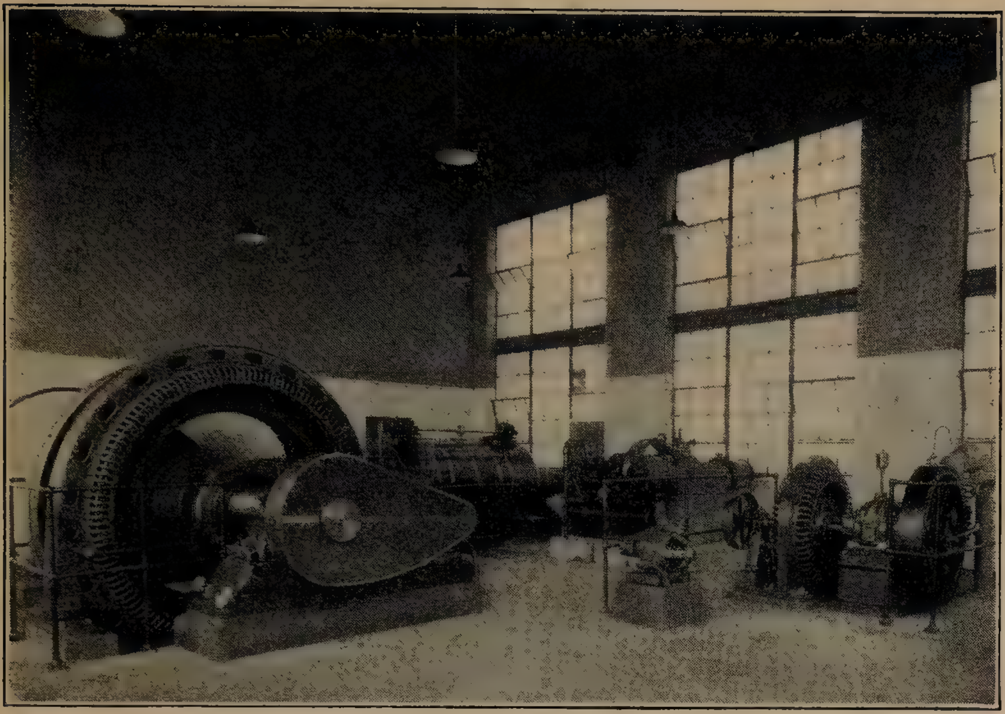
We come back again to the ever-interesting item of cost, and we know that heat and energy units are a fixed value never altered or modified by considerations of quality.

Yet the determination or prediction of their cost is not always simple. For a single case in point, suppose you are generating both energy and heat in your plant. How much of the expense is chargeable to each? If you are utilizing exhaust steam you figure one way. If you are not, you figure another. Your computation must be based upon accurate plant data and upon correct thermodynamic principles. You must be able to solve the whole problem of total cost of operation: (1) Under present conditions; (2) Under properly improved conditions; (3) Under conditions of buying all or part of your power and making your heat. Into these must enter fixed charges on improvement expenditures.

The total and unit cost of buying power for your plant can be computed rather easily if you have determined your power-load characteristics, including such items as monthly total energy, maximum demand, installed-motor ratings, and reserve capacity required. The next step is to obtain your local power company's contract form and do a little careful arithmetic, not forgetting coal charges and on which side of the transformers the current is metered and who pays for the meters and equipment. Most of these contracts are simple. Others require a Philadelphia lawyer to interpret and a higher mathematician to compute. However, all this is the easy part of the job. It is the understanding of your own power and steam conditions, allocation of costs, and possible and practicable improvements which require a good deal of interest on your part, and analysis and special knowledge of power plant and heating practice which you must in some way obtain.

But when you finally get all this information you will know definitely whether you can save the most money by buying power or making your own, or by combining these methods.

Purchased power has become a wonderful development and a factor of tremendous economic importance in our industrial program. Only recently there has been announced the linking together of a 10,000,000-horse-power system, extending from Boston to Florida. This comprises a tie-in of both hydro-electric and carbo-



The last few years have witnessed remarkable advances in the field of power engineering. Attainable efficiencies are far above what they were.

electric generating stations. It is said to be the world's greatest interconnection of power systems.

It is an interesting fact, however, and one well worth noting, that not only have power consumers been flooded with voluminous and very able selling propaganda in the interest of "superpower," but also that there has been no organized counter-propaganda on the other side of the question. The reasons for this are readily explained and understood. But the fact remains. And the result has been to cause a prejudice in the public mind in favor of purchased power. The impression so produced is strong, though not always tenable in the light of unbiased engineering analysis, which must always be relied upon for the right answer in any specific problem of application.

A good many manufacturers who were reasonably well-satisfied with their power situation have discovered that they were satisfied without adequate grounds. By the application of a thorough study of their steam and power conditions and costs, combined with a thorough knowledge of modern power-engineering possibilities, they

found the most economic solution. This was characteristically different in each case. Just a few typical cases—actual instances out of the past few months—are quoted below.

Example 1. Can Manufacturing Company. Investigation proved the possibility of completely shutting down the older and very wasteful boiler plant of the two which were being operated. An 8-inch steam line, 1,600 feet long, was therefore installed to carry steam from the good plant to the service mains of the other which was then shut down. A direct saving of more than $20,000 a year resulted, at a cost of $9,000.

The company needed more power. A study of this situation proved it was cheaper to buy the additional power required than to extend and modernize the power plant. Also it was found that purchasing nearly all the power during the non-heating months would be cheaper than operating the existing engine-generator sets and wasting the exhaust steam. Conversely, it would be cheaper to make the plant's power in winter when the exhaust steam could be used for building warming.

It was possible to carry out these plans owing to the low rates for current offered by the public service company, together with a flexibility of contract which provided reasonably for the wide range of summer and winter demand and furnished the required reserve.

Example 2. Food Products' Plant. About half the required current was being purchased, the rest was being made. The electric contract was exceedingly complicated. The company's boiler and generator equipment was ample for full requirements except a certain standby need. For the latter it was found cheaper to retain the public service than to install new power units for this purpose alone. A cost curve was developed by painstaking analysis to show the total cost of power and heat when buying different percentages of the total and generating the balance, taking into account such use of exhaust steam as was possible. The latter varied with the season and this element was included in the cost analysis. The final result proved it was possible to open one switch, cutting out the bulk of purchased power, and open one throttle to start an engine-generator set, and, without spending a dollar, to put into immediate effect a saving of $15,000 a year. This was done.

The balance of the study brought to light savings in boiler plant and, through proper scheduling of the steam load, in further use of

exhaust steam and other minor items, savings of $10,000 a year for an investment of $18,000.

Example 3. Chemical Manufacturing Plant. This plant purchased the major portion of its power and made the rest. A complete study of the generation and distribution of steam and power throughout the plant, including process requirements, of which there were many, together with a survey of the boiler plant and fuel supply, resulted in the following changes. It was found possible to install a 100 kw. steam turbo-generator exhausting against a back-pressure of 40 pounds for use in process work, replacing direct boiler steam. The purchased power was retained to balance the power load. A change was made in the purchasing of the fuel. The total result with some minor changes figured a saving of $16,000 a year on an expenditure of $12,000 capital invested.

Example 4. Woolen Manufacturing Plant. It was necessary to double the steam output of the boiler plant in the same old boiler room. This was done by installing modern water-tube boilers with high settings in the place of the old horizontal tubular boilers. Economies were put into effect which went a long way toward paying for the new investment by changing the type of fuel used and installing modern stokers and combustion-control apparatus. The evaporation results are 20% better than with the old plant.

Example 5. Large Fiber Manufacturing Plant. All power was purchased at a low rate. But owing to the opportunity for introducing exhaust steam at different pressures from a bleeder-type turbine, it was possible to make such a saving as to pay for the installation inside of two years.

Example 6. Large Pulp- and Paper-Plant. A very old and wasteful boiler plant was replaced by a modern boiler plant burning powdered fuel to take advantage of much cheaper coal. Savings should pay for this plant in three and one-half years.

Heat and energy are independent of quality variation, but it requires knowledge to be sure you are getting them at lowest cost.

Perhaps you were doing very well a few short years ago. But the last few years, a short period, have witnessed remarkable advances in the field of power engineering. Attainable efficiencies are far above what they were in, say, 1920 or 1922. These changes are not confined to the practice of the large central power station. They have likewise greatly widened the possibilities of making cheap

power in the individual manufacturing company's own power plant.

The situation calls for an up-to-date review as applied to each individual manufacturing establishment. Each one is different in its numerous individual factors bearing on the power problem. While steam for heating and process is a most important one of these factors, it is only one of the many upon which the right answer must be predicated.

It may be cheaper for you to buy power, but unless you understand the making you can only guess.

And guessing is always dangerous when it is not necessary. If you are guessing instead of knowing in the light of the most recent proved findings of power-plant engineering, you are probably losing money you might be saving.

That, of course, is your privilege!

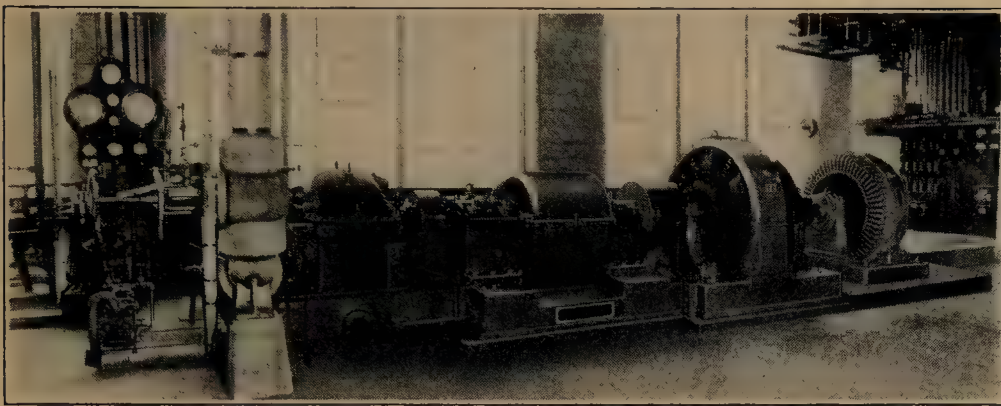
—David Moffat Myers in *Factory,* December, 1927.

EXHAUST STEAM FOR PROCESS WORK

WHEREVER heat is used at temperatures low enough to permit its being supplied by exhaust steam under back pressure, or, on the other hand, where processes exhaust steam at a pressure sufficient to operate a low-pressure turbine, power can be produced at comparatively low cost.

The illustration shows a geared steam-turbine driving a 600-kw. direct-current generator and a 500-kw. alternator in the plant of the Crown Willamette Paper Company, West Linn, Oregon. This unit supplies power to what was at the time of installation the fastest newsprint machine in the world. It was originally fitted with a direct-current generator for graduated-speed drive of the separate sections of the machine. But it was found that the paper-machine did not require as much power as the turbine would produce when using the amount of steam needed to heat the drying rolls. To cause it to use more steam, a 500-h-p. synchronous motor was connected to the shaft of the direct-current generator.

This motor is synchronized with the mill alternating-current power lines, and by acting as a generator makes it possible to load the turbine so that the proper amount of exhaust steam is produced. To insure constant speed of the generating unit, the pressure-stage turbine is fitted with a governor. The turbine runs at 3,600 r.p.m., while the generators are standard speed machines of 900 r.p.m.



A geared steam-turbine, driving a 600-kw. direct-current generator and a 500-kw. alternator, supplies power to a fast newsprint machine in this mill.

Steam pressure is 175 pounds gage, with 100 degrees superheat, while the exhaust pressure varies from 5 to 15 pounds gage. The equipment as now arranged is very flexible, and under almost all conditions the exhaust of the turbine is sufficient to take care of process steam demands.

POSITIVE LUBRICATION THAT ELIMINATES RISK

NINE large drawing presses at Dodge Brothers Motor Company, Detroit, are equipped with safety lubricating systems which not only are constantly earning a profit on their investment through economies in lubricant consumption, maintenance expense, and production time, but which also serve to prevent injuries to workmen. With them it is possible to apply grease to all bearings from one central point, eliminating the risks attendant on lubricating a machine in operation or on reaching bearings located between close clearances.

The system installed in each machine consists of a lubricator, into which grease is loaded as needed, and an arrangement of piping through which an adequate supply of lubricant is forced to all bearings. Trunk lines run to various parts of the press, and as far as possible only journals of a given speed are connected to the same feed line. Crank-bearings, which require more frequent greasing, are serviced by separate lines. Equal distribution is obtained by a pressure reduction valve located at each bearing.

A measured amount of pressure is applied to each line and is recorded on a special grease gage attached to the system. A semisolid

grease is used; oil drip is effectually prevented. The grease stays in the bearings and the presses may be kept in a much cleaner condition. The possibility of shut-downs caused by overheated or prematurely worn-out bearings is reduced to the minimum.

Again, if these presses were lubricated with individual grease-cups or sight-feed oilers, it would be necessary to construct permanent platforms so that the oilers might have easy access to all bearings. With this system, on the other hand, the lubricator is mounted in a convenient position on the floor, doing away with the need for costly platforms and making a substantial saving in plant investment. Many plants using this system have adopted a portable platform for use when disassembling presses for repairs.

CHECKING STEAM CONSUMPTION CUTS FUEL COSTS

BOILERS may be operated at high efficiencies by the most economical methods, but if there is no check on steam consumption, the efficiency of the boiler-plant operation can be offset in a large measure by the wasteful use of the steam produced.

That it pays—and pays well—to check the use of process steam is instanced in the practice of the Flambeau Paper Company, Park Falls, Wisconsin, manufacturers of paper stock and sulphide papers. At this plant, where the cost of steam represents between 40 and 50% of the total cost of production, 18 flow-meters give accurate figures on the cost and consumption of steam, and according to C. E. Wells, chief electrical engineer, have been partly instrumental in saving the addition of a 300-h-p. boiler and in cutting fuel costs approximately $6,000 a year.

The records made by the meters give the cost of the steam used by various units in the mill, and from them can be determined accurately the most important cost entering into the products. Steam waste has been reduced, for example, on the digesters. They use a large quantity of steam, and in order that they may operate at greater efficiency it is necessary that the boiler room be fully prepared to meet their demands. Consequently a bell signal sounds in the boiler room when a digester is about to be thrown on the load, and the indicators on the boilers make it possible to meet this heavy load in time to secure the best operation of the digester.

The cost of operating the flow-meters is small in view of the savings effected. Basing depreciation charges on 20-year life of the

equipment, and including interest on the investment, repairs, maintenance, power, labor and charts, the daily cost is $2.70—15 cents a day for each meter.

PULVERIZING PLANT PROTECTS THE COAL PILE

THE pulverizing plant of the Ohio Brass Company, Mansfield, Ohio, was originally designed to handle 5 tons of coal an hour, but is now being increased to twice this capacity. It supplies fuel for a 20-ton reverberatory furnace, six 20-ton annealing furnaces, and two 350-h-p. water-tube boilers which generate steam for process work. The equipment is entirely automatic, the schematic drawing showing how coal is handled from track through crushers, drier, pulverizer, and into transport lines to the furnaces.

The boilers operate on a load which varies from 50% to 200% of rating, and the pulverized fuel handles these fluctuations very satisfactorily, analyses of waste gases showing an average CO_2 content of 12½%. In 1925, 8,400 tons of pulverized coal were consumed, with an operating labor cost of $2,398.46, or 28½ cents per

Pulverizing equipment at the Ohio Brass Company makes combustion control positive and returns 21% annually on the capital investment.

ton of coal pulverized. All repair and maintenance costs for the period totaled 2.9 cents; the cost of unloading and handling the coal averaged 9.98 cents; and the total power cost was 65.4 cents per ton of coal pulverized.

The results obtained from this pulverizing plant show an annual saving of 4,000 tons of coal, amounting to $24,000. Combustion control is simplified and made positive, and the labor item reduced by $3,000 yearly. Inasmuch as the pulverizing equipment, including building, cost nearly $125,000, these savings show an annual return of more than 21% on the capital investment.

FITTING THE PIECES INTO THE POWER PUZZLE

IT'S something like a picture puzzle, this matching up the power units in a large plant so that they'll fit together for maximum economy. Each combination of plant conditions seems a little different, and it's a case of shifting about, trying new arrangements, until the right plan falls into place.

The S. D. Warren Company, manufacturers of paper, have developed an unusual combination of units, which at the same time is so simple as to be suggestive to other plants which have not yet "fitted all the pieces into the picture puzzle."

At a certain point in this plant there is a regular demand for low-pressure steam, and unless the energy expended in reducing the pressure from boiler pressure could be utilized, there would be a deplorable waste of potential power. To obviate this waste, it was determined to install a 400-horse-power turbine which would drive a centrifugal pump. The pump was to deliver water from the filters, which purify the river water, to the general circulation system of the plant. It was found that there was a pretty fair balance between the requisite amount of low-pressure steam which the turbine would furnish and the amount of water which the pump would supply.

It is imperative, however, that a constant flow of water at the required pressure be maintained. Since there is some fluctuation in the demand for steam, a synchronous motor has been installed on the same shaft with the pump and turbine. The synchronous motor runs constantly. When the full complement of steam is being used, the synchronous motor runs idle; but that is not a waste of energy, since it acts as a synchronous condenser to correct the power factor. When the demand for steam falls off, the turbine is partly shut down

so as to avoid waste, and the synchronous motor then acts to keep up the performance of the pump, besides functioning as a power-factor corrective.

At times when no process steam at all is required, or in case of a breakdown of the turbine, the turbine, the synchronous motor, and the pump connected to it are shut down, and an independent pumping unit is used instead. This is driven by an induction motor and can be started instantly by pressing a button and opening a valve.

These two units not only act as very complete conservers of heat energy, but they have also made it possible to do away with a water reservoir, thus making space available for other more productive purposes.

DIESEL PLANT SOLVES THIS MILL'S POWER PROBLEM

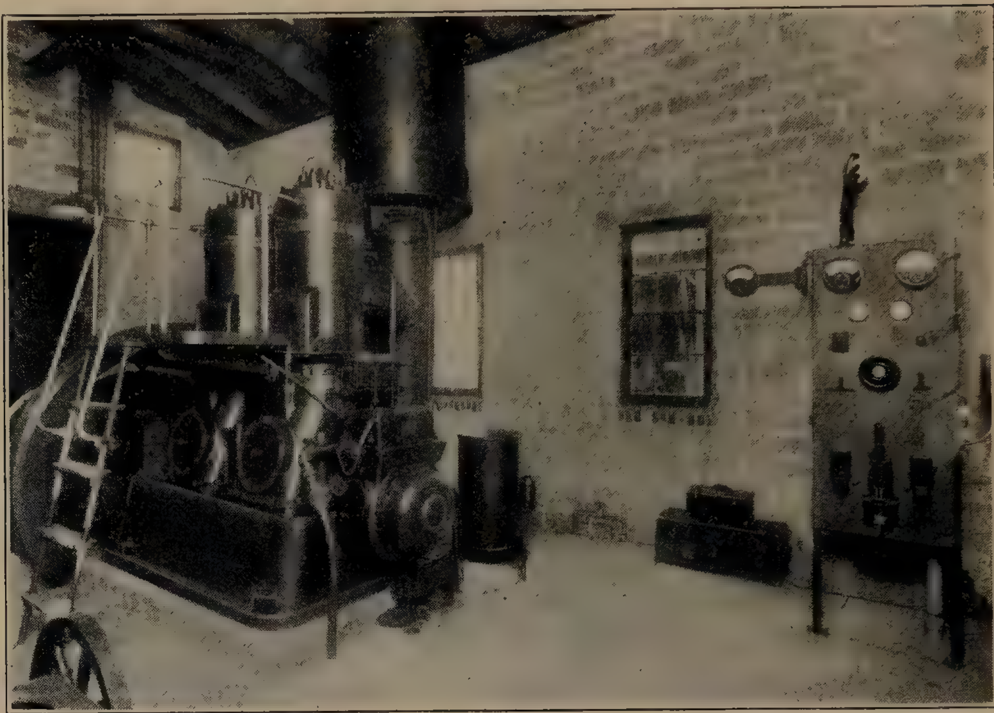
ONLY by knowing the cost of purchasing power and then comparing the results with the cost of making power in the most economical way is management in a position to answer the question whether it is preferable to make or to buy power. It is less trouble to buy, but oftentimes an analysis of costs will show that, for a given situation, it is cheaper to make. And when a company can save $3,000 annually in power costs, by operating, as it happens, its own Diesel plant—which is the experience of the North East Feed Mill at Minneapolis—the saving provides the best answer to the problem.

The cost of purchased power at this mill to handle approximately 17,000 tons of mixed and ground feed a year, of which about 8,000 tons represents grinding load, was $3,948. Power curves showed that the maximum load came normally when two hammer mills and the roller mills were grinding, and when grain was being elevated. This total load, however, did not exceed 80 kilowatts.

It was found that a 120-h-p. Diesel direct-connected to a 90-kv-a. alternator would handle the work with sufficient margin of safety.

Based on the normal year's operation it was calculated that fuel and lubricating-oil consumption would amount to $851.54. The total operating saving, therefore, figured $3,096 for the year, all of which can be applied toward the investment cost or can be segregated into interest, depreciation, and profit accounts as desired.

Perhaps even more important than the estimated saving is the fact that with this cheap power the company is now able to operate the mill on a 24-hour basis which will, of course, greatly increase the



By operating its own Diesel plant, the North East Feed Mill at Minneapolis saves $3,000 annually over the cost of purchased power.

savings. Moreover, the cheap power enables the company to specialize on finely ground feed for which the consumer is willing to pay a substantial premium.

WAYS TO AVOID STEAM WASTES

IN AN industry where considerable amounts of steam are used in process work there are many inherent possibilities for the management to show its ingenuity in avoiding waste. In some instances the measures necessary to avoid waste are very simple, whereas in others they may be of varying degrees of complexity, depending on the nature of the operations. Thus, for example, the installation of a non-condensing turbine as a reducing valve for low-pressure process steam may result in securing important blocks of electrical power as a by-product. In other cases, where chemical processes are carried on side by side with the reclamation of waste materials, the arrangements may become much more complicated. In such cases, they may be a combination of several simple methods.

In an efficiently laid out paper-mill, we find rather elaborate pro-

vision for conserving heat. In the first place, as described in previous articles, it is essential to have a meter installation which will show how much steam and water are being used at various stages of the processes.

With these quantities known, it becomes possible to determine the most efficient means of utilizing the heat energy which would otherwise be wasted.

In the Tyrone plant of the West Virginia Pulp and Paper Company there has recently been put into effect a new scheme of steam and water cycles for power and process purposes, which is an apt illustration of how a problem of this kind may be handled, and which has resulted in net savings of something like 30% in steam consumption for the whole plant. While it is impracticable to enter into a detailed description of the processes at this plant, it may be suggestive to other plants to make a simple statement of some of the ways in which waste is here avoided.

All of the steam is generated at 175-pounds pressure. There are three boiler-houses, in two of which coal is burned and in the third, refuse. The steam from one of these boiler-houses is passed to three bleeder turbo-generator sets, totaling 5,000 kilowatts, with a back pressure of 20 pounds. This low-pressure steam is used in six different processes and is finally returned to the boiler feed. All of the low-pressure steam from two of the turbines, however, cannot be used in the processes, and the surplus is condensed. The warm condenser water from these is used at two or three other points, and a portion turned into the boiler-feed line.

There are two other groups of engines. One of these, consisting of three reciprocating engines and totaling only 660 kilowatts, is straight condensing, but the hot condenser water is used for process work. The other group of engines, consisting of four reciprocating engines and aggregating 380 horse-power, is non-condensing, takes steam from the boilers through reducing valves at 120-pounds pressure, and has a back pressure of 20 pounds. The low-pressure steam from two of these is used for one of the pulp mills and that from the other two engines is turned in with the low-pressure steam coming from the turbines.

Thus it will be seen that all of the process steam, except in one instance where high pressures are required, is obtained from the exhaust of prime movers which furnish electrical power and drive four other departments.

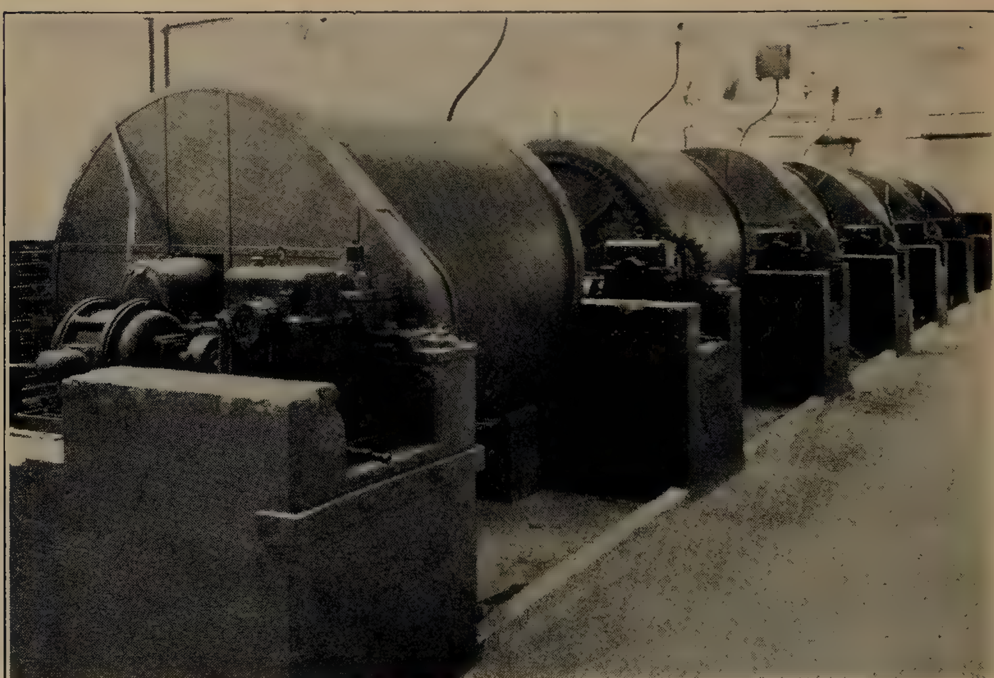
The whole saving which has been made in steam consumption is not due to the use of exhaust steam alone. It is due also, in part, to improvements in the arrangement of piping and heat insulating, and the use of steam traps.

Of equal importance are the meters which have been installed and which make it possible for all those in the organization who are responsible to see to it that steam and water are not wasted and that the different units are functioning properly.

UNIT DRIVE SAVES MONEY IN THIS POTTERY

THE goal to seek in power transmission is to apply that method which best fits the individual job. Often, of course, this proves to be group drive; again it may be unit drive.

An interesting instance of how such a problem was solved is found in a battery of six pebble grinders in a Trenton, New Jersey, pottery plant. They were originally driven from a 50-h-p. motor. In order to avoid a high-peak load the grinders were operated at night when the remainder of the plant was shut down, running for variable periods, depending on the weight of the batch contained and



Lower costs and increased speed resulted from the installation of individual drives and anti-friction bearings on these pebble grinders.

the desired consistency of the finished product. The motor, therefore, was carried through a large part of its run with a very light load and correspondingly low efficiency.

It was decided to install worm-gear drives from individual motors. Also, the mills were redesigned so that the trunnions were carried on anti-friction bearings.

Resulting from this substitution was an increase in grinding speed and a reduction in the time required to work through each batch produced. The grind is now completed in 54½ hours as against the 96 hours formerly needed, and four mills now do the work of six.

Labor is reduced to one man where two were needed, and maintenance costs are much lower. Total operating costs have been reduced 33%.

There is greater uniformity of product, and the residue from each batch of slip has been reduced from eight to two buckets.

HOW POWDERED COAL REDUCES COSTS

THERE is a disposition on the part of manufacturers, particularly those who make their own power, to consider the power plant as the ugly stepchild among the members of the large family of manufacturing processes.

Too often does a manufacturer investigate costs or operation methods no further than the various points at which power is delivered to drive his machines.

But in these days of the keenest sort of manufacturing competition, management cannot overlook the opportunities for reducing operating expenses afforded by modern refinements in power plant engineering. Whether he makes it or buys it, the manufacturer is apt to consider that power is a commodity which he must purchase at a market price, without investigating the possibilities of lowering that price by making an attempt to control the elements of which power is made.

There are a number of refinements which have recently been made in power plant practice of which the manufacturer can avail himself to his advantage. And among the most valuable of these advantages in power plant engineering is the use of powdered coal.

Though in the cement industry are found the first records of powdered coal firing, the public utilities and particularly the light and power companies have been quickest to develop this flexible

system of boiler firing. And now, though the use of pulverized fuel is such a comparatively new thing, it has spread throughout all industry, and installations designed for firing with pulverized fuel are to be found in manufacturing plants where the power requirements range from a few hundred horse-power to hundreds of thousands.

Much new information has been added within the past few years, showing the range of application and the flexibility of the use of powdered coal—such information having been secured mainly by the manufacturers of pulverized coal installations, and the prime movers committee of the National Electric Light Association—but it is the intention here only to cover the "high spots."

The editors of FACTORY *and* INDUSTRIAL MANAGEMENT have investigated operating conditions in numerous plants. The purpose of this survey is merely to bring together in summary form the high spots of this important and comparatively new method, which may be worth the plant executive's knowing if and when the question arises as to the possibility of powdered fuel being used to reduce costs in his own power plant.

One of the principal advantages which the survey indicates is that, appropriately employed, pulverized fuel equipment makes it possible to use advantageously almost any type of fuel. Another advantage lies in extreme cleanliness secured in the boiler room. Still another lies in the fact that the percentage of ash and coal makes less difference when coal is burned in pulverized form, and a fourth advantage lies in the possibility of obtaining a higher boiler efficiency. The principal disadvantages usually associated with this process in the minds of plant executives—abrasion of refractory walls and the coal-dust hazard—have been practically overcome by recent refinements in equipment.

As to the extreme flexibility of pulverized fuel installations, one manufacturer reports that after the first unit pulverizer had been installed in his plant and its operation compared with firing as previously done, the savings were found to be of sufficient magnitude to warrant the installation of additional pulverizers. So a second pulverizer installation was then ordered. In less than six months after the second pulverizer was ordered, a third machine was purchased. The fuel burned was either coal or tar pitch, a by-product of asphalt manufacture. Whether coal or tar pitch is used depends upon the

Pulverized fuel installation on a malleable iron melting furnace. Floor hopper and elevator for filling coal storage hopper above pulverizer.

market prices prevailing. The pulverizers carry without difficulty a boiler rating up to 200%, and the operation on pitch was equally successful with that of powdered coal.

One pulverizer has handled 6,500 tons of this fuel without the necessity of replacing any pulverizing parts and the second machine at the end of five months had handled more than 2,700 tons of fuel without the casing of the machine having been opened.

The ultimate analysis of this fuel showed a carbonic percentage of 93.71, 4% hydrogen and fractional percentages of oxygen, nitrogen, and sulphur, with no moisture. The heating value of the fuel is 16,135 B.t.u. per pound and the weight of ash and refuse has been found to be less than ⅓%.

Further evidence of the flexibility of this type of firing is supplied by an oil refining company. This company has an installation consisting of two unit type machines on two of the sixteen boilers in use. They were installed for the purpose of consuming any surplus petroleum coke which could not be otherwise disposed of. The installation represents a conversion of only part of the boiler house and it was made in connection with other changes for burning acid sludge.

A common conveyor for the two systems was installed and this was operated intermittently, the two fuels being alternated and delivered into the respective hoppers of the pulverizers and stokers on the other boilers. These pulverizers were operated for only about six months due principally to the fact that the conveying equipment had to be used continually for sludge burning operation. The company had plenty of coke storage space so preferred coke burning with stoker operation. This manufacturer reports a handling cost ranging between $1.00 and $1.50 per ton which is considered rather high. Under the circumstances he reports the installation and operating costs are probably not representative of ordinary conversion installations.

A steel car company in Indiana several years ago equipped their 250 h-p. boilers with unit pulverizers. Results secured with the various fuels available in that section of the country were tabulated and showed a B.t.u. content per pound of fuel varying between 9,000 and 11,200. Thus there was given assurance that the Indiana and Illinois fuels, which had previously been difficult when burned by grate firing, could be used when the market prices were right.

This manufacturer points to the simplicity of control as the predominant advantage of powdered coal for the small industrial plant. This ease of control is coupled with ability of the operator to burn any fuel available at the most attractive market price.

According to the report of the prime movers committee of the N. E. L. A., a municipal gas and electric company in Iowa burned coal from seven states—Iowa, Illinois, Indiana, Kentucky, Arkansas, Oklahoma, and Colorado—at one station during 1926. The variation was made more complete by the use of coal from several fields in each state. The Colorado coal was not the lignite variety but was a semi-bituminous coal. Northern, southern, and central districts in Illinois were tried while all Kentucky coal came from various fields in the western part of the state. These coals varied in moisture content from 4% to 16%, in ash from 9% to 20%, and in heating value from 7,700 to 13,000 B.t.u. per pound. With one exception, all of these coals were successfully pulverized, transported, and burned. This experience, the company points out, emphasizes the fact that moisture alone does not determine the fitness of the coal for use in pulverized form.

Additional evidence of the flexibility of pulverized coal installations is found in the report of one manufacturer that his machine has been found to adapt itself successfully to handling coal of widely diverse characteristics. Pocahontas, Southern Illinois, Pittsburgh, Western Kentucky, Youghiougheny, Dominion, Nova Scotia, Wyoming, and Colorado coals, and Formosa dust and petroleum coke are some of the fuels now being burned through the medium of this unit.

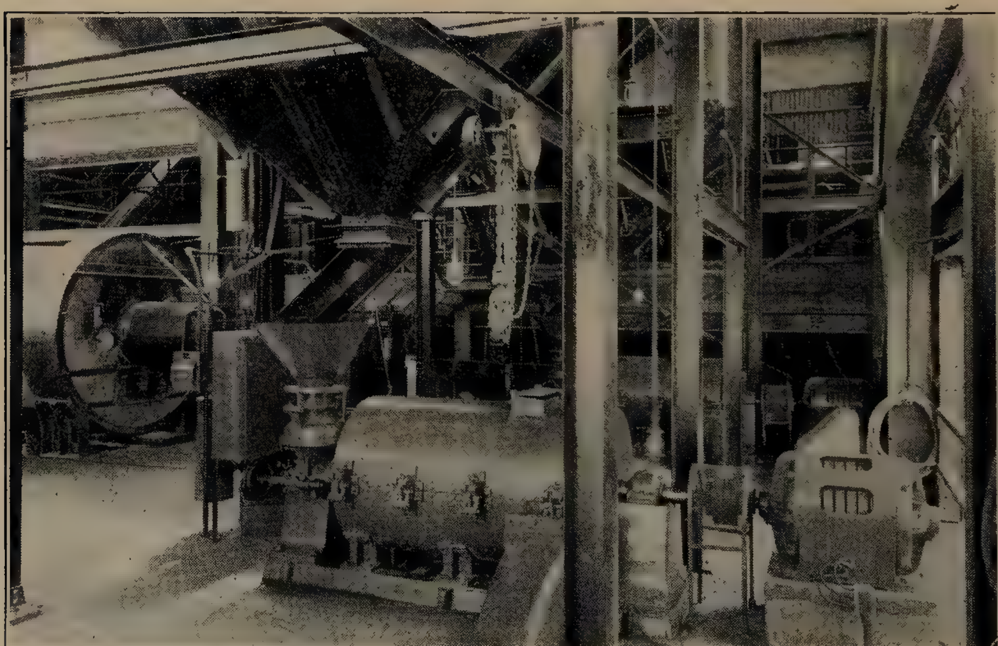
To make the picture as complete as possible, extracts from several general experience letters are printed below. The first is from a salt manufacturer, the second from a paper manufacturer, a third from a steel and iron company, and so on. The salt manufacturer reports as follows:

"Within the past eighteen months this company has changed two 905-h-p. boilers from underfeed stoker to pulverized coal firing. This change necessitated enlarging the furnaces by building them out about 6 feet in front and lowering the bottom about 6 feet. The time required to make this change was slightly in excess of three months for each change which was done during a period when the load on the boilers was below normal so that the output of the fac-

tory was not affected. One of these furnaces is of a solid firebrick construction and the other is equipped with a combination air-cooled and water-cooled wall.

"We find that we get about a pound more water evaporated per pound of coal with the pulverized coal than we did formerly. We are also able to carry considerably higher loads on the boiler, particularly on the one equipped with the air-cooled and water-cooled walls. We do have some trouble with slagging in the solid brick furnace when high ratings are carried, but have no trouble at all in this regard on the furnaces. We would certainly recommend that in any installation where loads in excess of 200% of rating are to be carried, the furnace be equipped either with water-cooled or air-cooled walls.

"We have laid off four men in our boiler room since making this change. We are using unit pulverizers and consequently do not find it necessary to store any pulverized coal. No rearrangements in our manufacturing process followed this installation in the power plant, the benefit from the installation being restricted to a reduction in the amount of coal and labor required. We have also noted a considerable decrease in our repair bill."



Rotary kilns being fired by unit pulverizers. The bin and pulverizer are shown in the foreground with the end of the rotary kiln to the left.

The paper manufacturer whose plant is located in Wisconsin, installed a new boiler and equipped it with unit pulverizers. Here is what he has to say:

"As this was installed on a new boiler the cost was considerably less than it would have been had we installed it in connection with the boiler then in use. In the new installation all we had to do was to run our foundation walls deeper than would have been required if putting in a hand-fired boiler. This additional cost we estimate to be in the neighborhood of $300.00 to $350.00.

"In tests which we have made, we find that our coal consumption has been reduced from 20 to 21 tons per day to 15 and 16 tons a day. At the same time we are generating more power as well as steam for drying purposes.

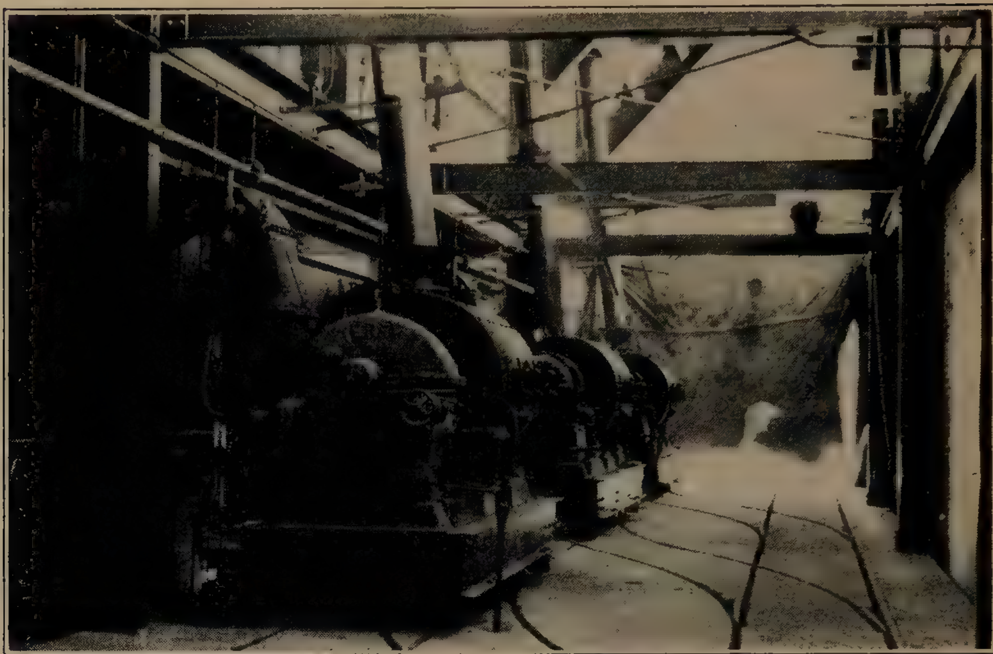
"We get screenings direct from the docks, 2 inches in size and under. These are dumped in an elevating bin and carried to the hopper of the pulverizer by an electrically operated belt conveyor, the fireman seeing to it that this hopper is kept filled."

Another paper manufacturer, this one in Massachusetts, reports that, "since the installation of the pulverized coal, we have been able to dispense with the services of nine firemen and an ash man.

"With pulverized coal burning, a large percentage of the ash is carried up the stack with the gases. Our 1,013-h-p. boiler, operating at 175% to 200% of rating, 24 hours per day, deposits only about eight inches of ash on the furnace bottom in a week's run, using coal with an ash content of from 7% to 8%."

A metal products manufacturer in Michigan says: "Before we installed the unit pulverizer, we added to our building another unit having a space 90 by 140 feet with beams 13 feet high and surrounded on three sides by glass windows, so that we added a great deal more heating surface than was previously used. We heated this additional space and made about one-half of our own power, using the exhaust steam for heating, and used less coal than we averaged for heating alone before."

The steel and iron company which reports, furnishes not only power needs for its coal mines, ore mines, quarry, by-product coke plant, blast furnaces, and concrete making plants, but also the entire municipal gas requirements of a large southern industrial city. In 1923 the peak demand for gas to the city had grown so that it was found necessary to supply some fuel which was readily interchange-



Pulverizers mounted on trucks so that if breakdowns occur they can be switched out of the way of replacement units without shutting down the boilers. The flexibility of this installation is obvious.

able with gas in order that gas could be released from the boilers to the city interchangeably, and as required. This company reports:

"After considerable study we decided on powdered coal and purchased a six-ton air-swept mill, a waste dryer, fuel burners and auxiliaries. The mill dryer and pumps were located in a fireproof building constructed for this purpose, and at the rear of the boiler house so that waste heat could be readily withdrawn from the waste heat duct which connects the boiler to the tank. The raw coal bin is located above the mill and is supplied with washed coal through an elevator from a track hopper. A short rubber belt conveyor takes the coal from the elevator over a magnetic pulley to the bin.

"The pulverized coal bins are above and in front of boilers three and five. Originally the combustion chamber of these two boilers were designed for vertical firing, employing a special-type burner standard at the time of installation. The washed coal supplied by the local company from a nearby mine frequently arrives with more than 10% moisture content which makes it difficult to dry the coal properly when full capacity is required. At such times difficulty has been found in maintaining the burner feed at a uniform rate. The

arches were also badly punished and were found to be in need of frequent repairs.

"In 1927 a 50% addition to the boiler was made and new-type feeders and burners installed. The combustion space was rebuilt and the burners relocated for both front and horizontal firing. These changes resulted in satisfactory operation.

"In 1926 the unit pulverizer for direct firing was installed and has performed in a satisfactory manner since. Due to the softness of the local coal the impact method of pulverization is used and has reduced repair costs to a minimum. As a matter of fact the only repair costs to this 5,000-pound-per-hour mill during an 18-month period has been the small cost of one set of hammers.

"Since these boilers are not operated at ratings above 225% it has not been necessary to use water-cooled walls. A hard reburned kaolin brick prevents the adherence of ash, and since this brick does not spall to any extent the lining has proven economical and reliable.

"The unit pulverizer fits nicely into the plant because, whereas, the central mill (number four) could supply three boilers by longer operation, too much would depend on the continued operation of this mill. During the midsummer the city demand for gas is at a minimum, releasing more gas to by-product boilers. This permits the stoppage of the central mill, cutting off one operator, while the single-unit mill, requiring little attention, continues to operate. As all pulverized coal boilers are equipped for gas-firing, operation can be changed from gas to coal or the reverse in from one to two minutes. Thus maximum flexibility is assured at reasonably high efficiency."

Though the greatest development in the use of pulverized coal has been in the utility field, installations in manufacturing plants both large and small have been numerous. Small-plant installations, for instance, include a meter manufacturer in Erie, Pennsylvania, who fires two 100-h-p. boilers with pulverizers; a paper company in Fitchburg, Massachusetts, has three 160-h-p. units; a textile mill in Uxbridge, Massachusetts, one of 258-h-p.; a manufacturer of building materials in Cleveland, two 250-h-p. units.

Then besides the practically unlimited range of power requirements to which firing with pulverized coal is applicable, the manufacturer is offered three principal methods of firing—horizontal, vertical and tangential. Powdered coal offers opportunities for savings

regardless of existing conditions, with little expense involved in the change-over.

Though but a few years old, pulverized coal has proven to be an economic fuel for making steam, and few boiler installations are now planned without giving it careful consideration. The manufacturer who has not fully investigated this comparatively new fuel has overlooked one of the prime possibilities of reducing his power costs.

—An editorial analysis in *Factory and Industrial Management*, July, 1928.

PROCESS STEAM AT 1,000 POUNDS PRESSURE

IN industrial plants steam pressures for process work are on the increase. A steam-boiler in the plant of the Mason Fibre Company at Laurel, Mississippi, is said to operate at the highest pressure so far employed for process purposes.

A boiler generates process steam at 1,000 pounds pressure to explode waste wood chips at the Mason Fibre Company, Laurel, Mississippi.

This plant manufactures a sawmill waste product called Presswood. First, a pressure of 200 pounds is applied to waste wood chips, and they are cooked in this way for 10 to 15 seconds. The valve is then opened fully and the chips are subjected to a pressure of 1,000 pounds. This pressure is maintained for the brief period of 3 to 5 seconds. Immediately after this the container is suddenly opened and the pressure released. This causes the chips to explode and a wood pulp of long fibers is produced. The pulp is then pressed into fiberboard.

The photograph shows the boiler which is a 4,000-square-foot cross-drum type. It has two-inch tubes ⅜-inch thick. The drum is a solid steel forging and has drawn ends 4 feet in diameter and 4 inches thick.

IV

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IV

MATERIALS HANDLING

MECHANICAL SCHEDULING

IN THESE days of narrow margins of profit, manufacturers in practically all industries are seeking every available means to reduce losses, to eliminate waste, to unlock idle working capital, and to earn a reasonable return on their invested capital. The developments of 1927 have all been of a sort which requires these improvements. Every indication is that 1928 conditions will intensify what 1927 brought. And in meeting these conditions, no manufacturing manager can afford to overlook the opportunities that mechanical-handling equipment affords to assist greatly in obtaining the desired results.

Consider, if you will, the direct results which the most efficient handling of materials will bring. Let us list what we may expect of properly selected and installed handling equipment: (1) Permit transference to the capital account a considerable portion of the overhead, as composed of indirect labor; (2) Reduce the manufacturing cycle; (3) Reduce the process inventory; (4) Speed up, coordinate, and stabilize production; (5) Facilitate obtaining accounting and production figures; (6) Substitute automatic mechanical scheduling for the complicated, expensive schedule boards and production systems; (7) Govern the layout of new plants and improve the performance of existing ones.

So let us consider briefly, in particular respect to current conditions and future trends, these several advantages of mechanical handling.

Many times a careful investigation reveals that a plant is actually expending, by way of the indirect-labor pay-roll (frequently buried in the factory overhead expense a burden), an annual amount which if eliminated by mechanical handling will pay for the necessary material-handling equipment in from one to two years.

A year ago I endeavored to obtain a measure of this for American industry as a whole. Taking the 1923 census figures for the annual pay-roll of American manufacturing as $14,017,107,000 and apply-

ing the factor of 22%—a widely circulated survey had recently shown that the average material-handling cost in manufacturing pay-rolls was 22%—we find that for 1923 this annual cost was the staggering figure of $3,084,000,000.

In a plant with an annual pay-roll of $1,000,000, 22% of this is $220,000. Now, this is the over-all measure, let us say, for the present state of the art. The difficulty with averages is they do not fit every plant, but only those where conditions are similar to the mass that produced the average. So the survey of our individual plant may show that only $70,000 is the amount commercially attainable. The combined annual amount for fixed charges and operating expenses would, for the conditions under review, average not over 33% of the amount to be invested in mechanical-handling equipment, or $23,100.

What have we done then to our balance-sheet? We have added $70,000 to the invested capital account and have reduced our overhead by the difference between $70,000 and $23,100, or $46,900. This means that the annual rate of reduction in overhead expense will retire the original investment in approximately 18 months; certainly a good investment.

Where the direct-labor operations can be subdivided and the individual times synchronized, continuous subassembly or final-assembly operations are speeded up by coordinated handling equipment. For any slowing up of production due to lack of, or faulty, material, or to incompetent or inexperienced operators, immediately shows up, so that the faults can be found and remedied.

Materials are right at hand and pass from operator to operator moving in a continuous stream. This makes for uninterrupted, continuous production. If this then is tied up to a proper and adequate means of wage-incentive payment, the manufacturing cycle sometimes can be reduced by as much as 50%.

The automobile industry is an excellent example of this synchronization and coordination. A completed car—finished in so far as assembly is concerned—is driven out under its own power every few minutes. This results in a manufacturing cycle so short that if cars were produced by any other means less efficient, the cost of a car would be prohibitive to the mass of present-day purchasers.

As a recent editorial* points out: "While one of the leading auto-

* *Iron Age*, July 28, 1927, page 277.

mobile plants required 17,000 workers in 1916 to turn out 650 cars a day, the present force in the same plant is approximately 15,000 and has no trouble in turning out 1,500 cars a day. Worked out in another way this means that in 1916 it took 26 man-days for each car against 10 man-days under present conditions. Installation of machinery for cutting down both time and labor, employment of mechanics and department heads specially trained in the work, proper routing of manufacturing operations through the plant, modern equipment for handling materials, and more exact methods of manufacture through the use of more accurate machines, all taken together account for this great improvement in performance."

Every time an additional worker is added to the productive payroll an amount of process inventory must be placed at his disposal for him to function properly in the production program. Again, if work in process is dammed up between operations, or too much stored in banks to insure production flow, working capital is tied up and idle. If we can then perform the required amount of work with less help, if we can smooth out the production flow so that all the work in process is flowing by means of mechanical-handling equipment and proper sequence of operations, we reduce the work in process required to accomplish a given production program.

There are cases on record where a carefully adapted and coordinated material-handling system, together, of course, with other improvements, has reduced work in process alone to such an extent that the fixed charges for interest, taxes, insurance, and depreciation on the release capital carried the fixed charges on the material-handling-equipment investment, so that the savings by reduction in the manufacturing cycle were a clear gain.

Carefully coordinated dispatch systems for moving material, if it is not on a continuous conveyor, together with other suitable means for insuring a free, uninterrupted flow of material, act as pacemakers in production, sustain its rhythm, and serve to smooth out what too often is a spasmodic flow of material, with the consequent interruptions to production.

Where the subassembly and assembly operations can be so laid out in proper sequence of operations that they may be adapted to a continuous system, the management must work out the entire details of operation so as to insure a continuous, but not oversupply, of raw and process material. When this is done production is speeded up

from 15% to 40% in ordinary, but not complicated operations. In some highly intricate assembly operations production has been speeded up to a considerably higher degree, and in some large-scale, continuous-production programs, production costs have been reduced to a point where markets were readily tapped which at the previous sales level due to cost seemed unattainable.

Too often there is no realization of the extent to which some form of mechanical-handling equipment, depending upon conditions, can be utilized to provide a continuous flow of material for a group of operations that may be complete as a group. Sometimes this is best worked out where the operations are mainly manual, or requiring only light tools, by the turntable method, enough positions being provided to accommodate each operation, so set that the same total times are required for completion at each station.

The mechanical-handling equipment, if properly designed, can obtain every advantage that is afforded to provide means for obtaining counts, weights, cases, unit lots, and the like, at the proper control points. Counters can be installed on continuous conveyors, gravity conveyor, or on overhead conveyors. Weighing sections can be provided for industrial tracks, conveyors, and monorail systems. Hook scales can be obtained for cranes and monorails. In many instances scale sections with suitable computing machines can be so arranged and mounted as to provide for transferring loads or containers from one conveying system to another. The weights, extensions, and summations may be recorded as the transfer is made. These records can serve as a basis for billing weights, stores records, production records, and furthermore as the basis for unit or group compensation.

Curiously enough, one of the principal cost-reduction influences brought by mechanical handling is a by-product, so to speak, of the handling problem. The mechanical-handling system itself automatically schedules production to a great degree. Where the product is of one style, size, or model the scheduling is 100% automatic, for the production line has a maximum fixed capacity of units per hour.

With the rate of production fixed by the first assembly rate of the production-line system, it is comparatively simple to work backwards and determine accurately the rate at which the subassembly, component parts, and so forth, are required to be delivered to the production line. The production line thus definitely fixes the rate of

production and this in turn controls or governs the component-parts production flow. We know that so many units of production, barring accidents, are going to come off the production line in a given period, and that to keep this going we must keep the process material, component parts, coming through at predetermined regular rates. Thus the mechanical-handling equipment of the production line automatically schedules and maintains the schedule of production.

No complicated system of schedule racks, boards, routing or follow-up system is required, for the moment that an important part —or as a matter of fact an unimportant part—fails to appear at its proper junction point, the failure is known immediately. No records show it; the fault appears automatically, visually, insistently.

It is, of course, essential that the supply of component parts—be they furnished from the outside or manufactured at the plant—be scheduled properly to insure a uniform flow of material to the production line. Railroads and truck fleets are used as almost continuous conveyors to bring material to the plant. The principal component parts are automatically checked off, or ticked off, on a continuous counter or automatic recording device that gives the record of what passed through or by that particular control point during a given period of time. A few records tell the story to the production supervisors and to the management.

Now, what does this all mean in terms of turnover of working capital? Simply this: The manufacturing cycle is predetermined and set, it is attained automatically, resulting in turnover as high as 50 to 60 times a year for some types of mass-production units, and as high as 200 to 250 on less complicated units.

Where a new plant is being considered, it is properly laid out around material-handling systems that will produce the desired results. This has a decided bearing on column spacing, ceiling heights, types of building, location of receiving points, component parts-production centers, in-and-out railroad spurs, and in-and-out trucking points. Relationship and interrelationship of production departments, production centers, and service centers, all must be governed by the choice that is made of material-handling equipment and systems.

Existing departments in existing plants can frequently be entirely rearranged to provide conditions that will permit of the adoption of

modern methods of continuous production. This is true even in the so-called intermittent types of manufacturing. Wherever mechanical-handling equipment can be so set up as to simulate continuous production, it serves as an automatic controller of the manufacturing cycle, increases turnover, and simplifies scheduling operations.

—Harold V. Coes in *Factory and Industrial Management*, January, 1928.

This crate spells lower packing costs and cheaper freight rates.

BETTER MATERIALS SAVE CRATING COSTS

MANAGEMENT'S opportunities to cut costs are not confined to the more important details of manufacturing, but are often to be found in seemingly trivial phases of the business. Take packing and shipping, for example. The Williams Oil-O-Matic Heating Corporation of Bloomington, Illinois, has found a way to save nearly $10,000 annually in shipping-room costs.

This economy has been made possible by the adoption of more expensive crating materials. The old crate was made of 1-inch yellow pine. The new crate is made of 5/16-inch birch with a frame of 1-inch gumwood. Since the board feet of material used are much

less than the pine required, the cost is actually 28 cents lower. Furthermore, the new crate is bound with wire to strengthen it and hold it in shape when subjected to unusual strains.

The crates come knocked-down and are easily assembled by unskilled labor. Morover, there is a saving in freight-rates, and since burners are shipped f.o.b. Bloomington, a total of $21,000, based on annual shipments of 35,000 burners, will be passed on to dealers.

As C. U. Williams, president of the company, points out, "The saving per burner is not large, but it is proving gratifying to dealers generally. And on large shipments it really is important, both to the dealer and to ourselves."

CONVEYOR SYSTEM RETURNS 93% ANNUALLY

IN THE making and handling of Ivory Soap and other Procter and Gamble products, mechanical methods are used wherever possible. Machines are used to do work formerly done by hand, and the movement of the work is effected by conveyors where their use is possible. The constant improvement in methods of manufacturing in the many Procter and Gamble plants has resulted in advantages, which are distributed to the consumer and employee, as well as to the owners of the property.

Conveyors are extensively used in all the plants, and have been used for many years. At times it is found that by a rearrangement of existing conveyors and additions to the conveyor system, further economies can be effected. Such a change was made at the Port Ivory plant, Staten Island, New York.

The plant at Port Ivory is the second largest Procter and Gamble plant. The warehouse was located north of building Number 5, where the soap is wrapped and packed, and east of the building where Chipso is made. We had a system of belt and roller conveyors which carried the boxes of soap from the sealing machines in building Number 5 through a bridge to the warehouse. Another conveyor brought the boxes of Chipso through a tunnel under the railroad tracks to the warehouse. The system worked very well except for excessive repairs, and spoilage due to crushed boxes.

However, the warehouse was too small to handle the increased storage requirements, and it became necessary to load some of the boxes on our railroad cars and haul them around the yard to our Park warehouse, which is located across the street and east of build-

ing Number 5. The boxes had to be stored in the Park warehouse, and when needed, reloaded and hauled back to the other warehouse.

Then another condition arose. We had increased the output of the plant to the point where more manufacturing space was necessary. It was thought that a new building or an addition to the Chipso building would have to be constructed. Finally, after a careful analysis, we found that by installing new conveyors and changing the location and direction of some of the old conveyors, we could use the Park warehouse, which had been an overflow warehouse, as the main warehouse and make a manufacturing building out of the old warehouse. This change would give us about twice the extra manufacturing space needed, and would stop the handling of the overflow to and from the Park warehouse.

The changes and additions to the conveyors were made as laid out. and the results have entirely justified our expectations. The new conveyor equipment consists of belt conveyors on the straight stretches and roller gravity conveyors at the turns.

The main addition to the conveyors system is the method of conveying the boxes from building Number 5 to the new warehouse. These two buildings were connected by a covered bridge, 243 feet long, extending from the third floor of the building Number 5 to the roof of the new one-story warehouse. Four conveyor belts run through the bridge, two belts above the other two. At the warehouse end the belt conveyors discharge in the middle of the warehouse, upon roller conveyors, two belts discharging toward one end of the warehouse and two in the other direction.

The changes in the old conveyor system and the additions to the system in building Number 5 and the old warehouse were made to direct the flow of boxes onto the four conveyor belts running through the bridge. One of the top belts handles Ivory Soap and the other Procter and Gamble Naphtha Soap. One of the lower belts handles yellow soap and soap powder, while the other lower belt handles Chipso and Ivory Flakes.

The Ivory Soap is wrapped and packed at the south end of the fourth floor of building Number 5. The boxes are sealed and then the belt conveyor carries them north and just below the third floor ceiling until they reach a point opposite the bridge. They then roll down a gravity conveyor leading to the proper belt going through the bridge.

The Naphtha Soap is wrapped and sealed on the third floor between the Ivory department and the bridge. The boxes are then conveyed on a belt, carried around the turn on rollers, and discharged onto the belt going through the bridge.

The yellow soap is conveyed from its packing operation at the north end of building Number 5, to one of the lower bridge conveyors in a manner similar to that in which the Naphtha Soap is handled.

Boxes of Chipso are brought to the first floor of the old warehouse building through the tunnel, as formerly, on a belt conveyor about 140 feet long. Now this unit discharges over a roller conveyor onto a belt conveyor which is about 375 feet long and which carries the boxes up to the third floor of building Number 5 and discharges the boxes upon the proper one of the lower bridge belts. Ivory Flakes also travel from the old warehouse on the same belt with the Chipso.

After the boxes are discharged upon the roller conveyors in the new warehouse, men pile them on platforms which are taken to the cars by electric lift trucks.

The old conveyor system which was in operation about 10 years cost $33,000. Part of the old conveyors were combined with new conveyors, costing, installed, $25,000 to make up the present system which represents an investment of $39,000.

The cost of operation of the new system is $5,238 a year, and the operating cost of the old system was $4,856 a year. Repairs on the new system amount to much less than on the old one, because the new system is composed entirely of belt and roller conveyors, which experience has shown to be least expensive to maintain.

Some of the old conveyors caused a large amount of damage and loss by spilling boxes and crushing them, which in turn resulted in damaging the soap packed in them. The loss due to this item was $5,000 a year.

By having only one warehouse instead of two, we have reduced the overhead in supervision and car checking by $10 a day. This saves $2,750 a year. The transferring of the overflow from the old warehouse to the overflow warehouse by railroad cars, cost for car switching $2.50 a trip. As an average of 6 cars a day were transferred, this cost $4,125 a year, which is now being saved. In addition, the extra handling due to transferring the overflow cost us $6

a car for labor. The saving brought about by the elimination of this handling is $9,900 a year. These savings total $21,775 a year. After deducting the slight extra operating cost of the present system there remains a net annual saving of $21,393 attributable to a reduction of 81% in handling cost.

To obtain the extra manufacturing space created by the change in warehouses, we would have been compelled to build a new manufacturing building at a cost of $250,000. The new layout using the overflow warehouse as the main warehouse, which was made possible by the present conveyor system, has thus saved us the cost of the additional building. At 6%, the annual saving in interest on the investment in a new building is $15,000. Adding this to the savings in handling makes the total saving effected $36,393 a year, which is a return of 93% on the cost of the new conveyor system.

A low ratio of handling cost to productive labor is most desirable. The former cost of handling the boxes amounted to 7.5% of the amount paid out for productive labor in the packing departments. With the new conveyor system this ratio has been reduced very greatly, now being only 1.5%.

The success of the present conveyor system has caused us to study other material-handling operations very carefully with the idea in mind of improving the other operations. As a result, we are making some changes at other points, which will still further improve the flow of work through the plant.

—H. C. Knowles in *Factory*, March, 1927.

THE SCALES GO TO THE JOB

MOUNTING automatic scales on movable platforms or suspending them from monorails saves time, steps, and labor at the Buick Motor Company plant. This plan is used both in the receiving rooms and in the assembly lines, affecting in some instances an 80% saving over the older methods of counting.

Scales are suspended from a monorail in the export department. No steps are wasted carrying parts to the scales. The operator knows the weight of each unit and can quickly count out the number of parts required for a shipment. Or master-sacks containing known amounts are used as counterweights.

Automatic scales are mounted on a movable platform in the steel-

yard of the drop-forge plant. The weight of a single steel bar is determined beforehand and the number of bars received from the rolling-mill can be quickly and accurately counted.

More than 300 automatic scales are used throughout the plant, and range in capacity from 15 pounds to 6 tons. A special department keeps this equipment in repair and adjustment.

SPECIAL GRAB CUTS HANDLING COSTS

A NEW grab offers an opportunity for substantial economies in the handling of bales of paper, rags, hemp, waste, burlap, or boxes. Weighing 200 pounds, it has jaws of spring steel to absorb shocks. And, as shown in the illustration, these jaws are protected and joined at their tips to reduce the pressure at any point on the bale.

Three men are required to operate this labor-saving device, one in the crane, one on the floor to guide the grab, and the third on the pile. Its use makes possible increased storage capacity, since the bales may be stacked more closely and within a very few feet of the crane bridge. A safe-locking lever grabs the bale at both sides in

Bales of paper are handled more economically and increased storage space is made available by the use of a powerful grab with jaws of spring steel.

one motion, reducing handling time, so that when the bale is placed on the pile the self-locking lever slips into position and is ready for another bale.

Once placed on the pile, the bale can be picked up with no other handling.

ECONOMICAL SWITCHING WITH GASOLINE LOCOMOTIVE

THE large industrial plant is frequently the proprietor of some miles of standard-gage track—virtually a small railroad of its own, and sometimes, indeed, duly incorporated as such. With the amount of handling of materials between neighboring plants, and switching of cars for loading or unloading, these few miles constitute a very busy, if short, railroad.

How this traffic may be handled is shown at the Morrell Street Power House of the Public Lighting Commission of the City of Detroit. Here a 14-ton gasoline locomotive is used in switching empty and loaded cars in their yards, the average haul being 1,000 to 1,500 feet.

Over a period of three months in 1927, the net tonnage hauled per day was 1,000 tons of coal. The maximum load consisted of three standard coal cars with a gross weight of 275 tons each trip.

The track gage is 56½ inches and there are no sharp curves or grades above 1%—factors in the low gasoline consumption reported, which ran between 15 to 20 gallons a day.

A NOVEL TYPE OF PROGRESSIVE ASSEMBLY

A GREAT deal of tugging, lifting, and pulling was eliminated by a simple plan at the Packard Motor Car Company. The motor crank-case had always presented a problem of handling in the motor assembly line, because it is ungainly and with the crank-shaft in place, quite heavy.

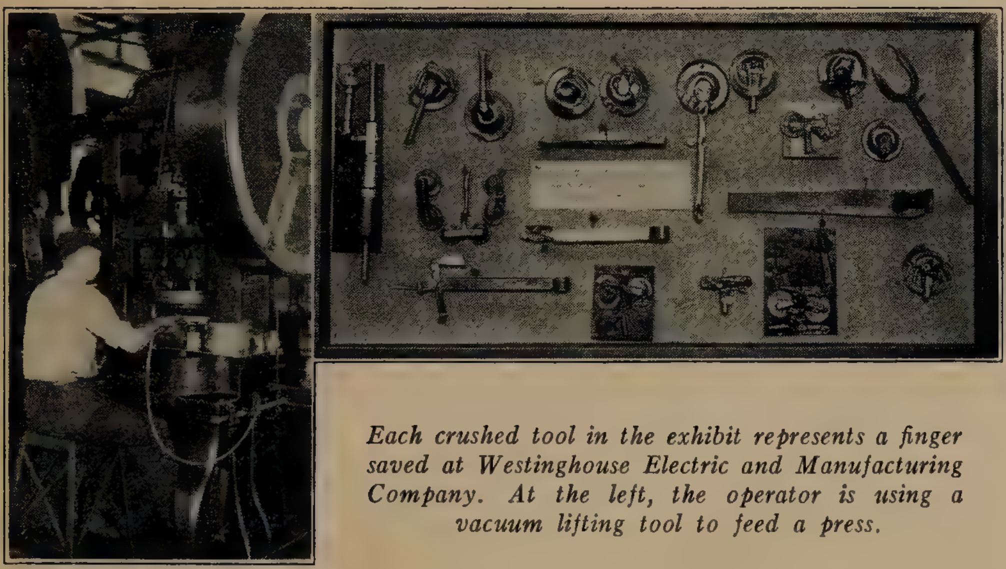
The difficulty was overcome by bolting wheels onto the crank-case through bolt holes used to fasten the motor at each end of the frame on the eight-cylinder car. The motor of the six-cylinder car has no bolt holes at the right place, so it goes upon an especially made fixture which is mounted on pulley wheels.

The crank-case rolls along a two-rail track on the fourth floor motor-assembly department, and as the last operation is completed

the complete engine—still on the pulley wheels—is rolled onto an electric elevator. The trucker who does this job operates the elevator automatically, and sends it down to the first floor when it has a load.

Again, when it reaches the first floor, the engine is rolled out—this time onto a truck which has side rails to receive the pulley wheels. The truck is pushed to the "jacking-in" stands, which are rail equipped.

After the engine is through on the jacking-in stands, it is ready to go on the testing block. A "bridge," which is merely a truck equipped with rails the width of the aisle, is wheeled up. The motor is rolled onto the bridge which carries it to the testing block. And the pulley wheels are taken off only when the motor goes into the automobile at the final assembly line.



Each crushed tool in the exhibit represents a finger saved at Westinghouse Electric and Manufacturing Company. At the left, the operator is using a vacuum lifting tool to feed a press.

SAFETY LIFTING TOOLS

BRINGING safety home to employees is the purpose of the display of vacuum lifting tools shown in the accompanying photograph taken at Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pennsylvania. Each crushed tool represents a finger saved and is tangible evidence of the number of serious accidents avoided in the press department. A brief glance at this convincing exhibit is enough to impress the majority of workers with the importance of safety devices and accident programs, and plays

its small part in keeping the whole subject of safety fresh in their minds.

The other figure shows how sheet-metal disks are fed into and removed from a press in safety by means of a vacuum lifting tool. With such a device, accidents become next to impossible.

A NOVEL MATERIAL-HANDLING METHOD

IN wheeling the returns from the tumblers at the Alamo Iron Works, San Antonio, Texas, the shortest route was directly under an overhead trolley runway for the greater part of the distance. It was formerly necessary for men to push wheelbarrows, piled high with gates and other pieces of iron, over the relatively soft surface of the aisles, while directly above their heads for the greater part of the way was an idle trolley rail.

In all plans for substituting the use of the rail for that of the wheelbarrow was the decisive fact that the trolley failed by at least 15 yards to reach the point to which wheelbarrows had to be taken. But, paradoxical as it may appear, the solution of the matter was found to be the efficient use of all three elements: man, wheelbarrows, and trolley.

The gates, broken castings, and other returns are piled into wheelbarrows, and their weights obtained by pushing the barrows over an ordinary platform scale sunk in the floor of the cleaning room. From there the barrows are pushed to a point directly under the end of the overhead trolley rail. The distances from the tumbling barrels to the scales and thence to the trolley rail are both very short, a few yards each at most. But from start of the trolley rail to the cupola where the load has to be taken is something over 60 yards.

A simple apparatus consisting of three stout chains with hooks at their ends solved the problem when fastened to a lever bar some five and a half feet long. This bar is hung to a hook on the overhead trolley by means of a rod equipped with an eye to slip over the trolley hook and a clevis to support the bar. The weight-arm of this bar is six inches long and the power-arm is five feet long. Near the end of the power-arm is another chain about a foot and a half long with a hook at the end. When the device hangs idly from the hook overhead, two of the three chains may be hooked under handles of the barrow, close up to the pan; and by pushing up on

the power-arm the third of these hooks may be hooked to the rim of the wheel of the barrow. Then by pulling down on the short chain at the end of the power-arm of the device the loaded barrow may readily be elevated several inches off the floor and held in suspension. By pulling down further on this little chain, its hook may be fastened to the guard that projects beyond and around the wheel of the barrow so that the operator is relieved of even the task of holding down the outer end of the lever.

Suspended thus on a free running trolley, the whole outfit may easily be pushed to a point convenient to the cupola. There the operator allows the long arm of the lever to go up and gently lowers the heavy load to the floor, whence it is pushed over a hard floor, free from sand, to the most convenient point. The barrows are taken back to the cleaning room in the same harness.

In this way it is possible to convey loads almost double those possible by hand operation of the barrows, and at double the speed at which a man can push a load through the loose sand. All factors considered, the device has made it possible to cut the cost of transferring materials from cleaning room to cupola two-thirds.

HANDLING HEAVY TRUCKS

THE National Biscuit Company of New York City has found a novel way to handle their heavily laden hand-trucks. It had been found increasingly difficult to hire men to push these trucks about the plant. Labor turnover was high, costs were mounting rapidly, and improved handling methods were necessary.

Hundreds of trucks were in service, varying greatly in length, width, and design. The cost of converting them into trailers would

Nine tractors equipped with automatic finger-type hitch do all the heavy hauling at the National Biscuit Company's plant in New York City.

therefore have been prohibitive. If they were to be handled by a power unit, they must be handled just as they were.

To solve this handling problem they adopted a tractor with an automatic finger-type hitch. The tractor operator backs into and engages any truck regardless of design. The fingers are lowered to pass under the truck frame, and to complete the connection are lifted to gasp a cross-sill. The weight of the truck is thereby shifted from the small front wheel and is borne on the other three wheels, lessening traction and turning resistance.

Nine tractors equipped with this finger device are now doing all of their trucking in the plant. And not a dollar was spent to modify existing hand-truck equipment.

An aerial tramway conveys lumber from the sawmill to the door factory three-quarters of a mile away at a fraction of the original cost.

AERIAL TRAMWAY LOWERS HANDLING COSTS

AT The Wheeler, Osgood Company, Tacoma, Washington, five men load and operate an overhead carrying system that conveys lumber from the sawmill across a stretch of lowland three-quarters of a mile long to the laminating machines in the door factory. They do the work which formerly required 150 men and 20 horses.

Formerly, lumber was loaded on a scow and towed around to the factory lumber-yard to be sorted. Now, in connection with the aerial tramway, conveyor sorting chains have been installed so that the lumber is semiautomatically graded. Also, stacking machines

are used to stack the lumber on the kiln-cars ready for the dry-kilns. In this way, the lumber-yard has been eliminated. One man assembles the graded lumber in packages of 500 feet, two more men put these packages into the slings and dispatch them on the tramway, and the remaining two receive the lumber at the discharge end and return the empty carriers. With this system, the cost of conveying lumber has been reduced to a fraction of the original expense. The cost of maintenance is negligible, and there has not been an accident or breakdown since the tramway was installed.

WEIGHING A CONTINUOUS PRODUCT WITH ACCURACY

IN THE manufacture of material which is made by a continuous process and in an integral strip, it has long been the custom to attempt to control the weight of the material produced by sampling it at infrequent intervals and setting the producing unit in accordance with the results thus indicated. The intermittent character of this control, and the fact that the weight of a small sample does not necessarily represent the average weight of an adjacent larger area, has at times resulted in excessive tolerance.

An attempt has been made to handle certain materials by gaging their thickness, but here again the indication is intermittent and the character of the material has generally been such as to render it difficult to accurately measure the thickness, and the dimension to which the micrometer or other gaging appliance can be read accurately is a large percentage of the total thickness, so that the permitted tolerance has to be large.

A scale on a roofing machine at the Chicago plant of Bird and Son continuously weighs a span of the material and indicates its agreement or departure from the normal weight. The device consists of a scale supporting a roller, which in turn supports the center of a horizontal span of the material. The scale is balanced so that only goods of the exact weight will bring the pointer of the scale to the zero mark. Heavy goods will move the indicator to one side of zero and lighter goods to the opposite side. The machine tender, therefore, by watching the indicator of the scale can determine almost as the material is made whether or not it is of correct weight, and if not, can at once change the setting of the control apparatus of his machine and note immediately the result obtained. The scale is equipped with a poise and graduated beam, and to set the apparatus

for any particular weight per running unit of length it is merely necessary to move the poise to an appropriate graduation.

At the Bird and Son plant the location of the scale is so high from the floor that the scale chart instead of being located on top of the apparatus is hung beneath it in order to furnish a scale reading at a height convenient to the eye.

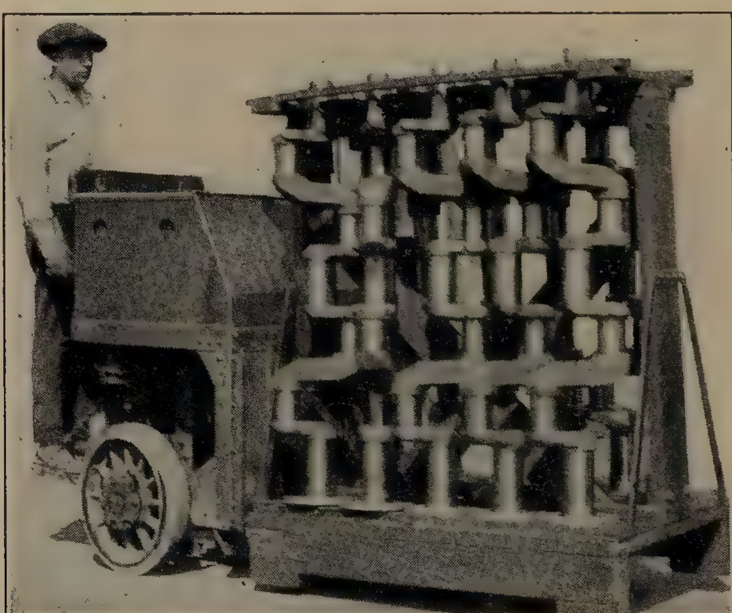
CRANES REPLACE SCAFFOLDS

IN THE old building of the St. Louis Car Company each section of a car was riveted while in an upright position. This method required a complete line-up of scaffolds. It was both costly and dangerous.

In the new building, the fabricating processes are done while the sections are laid down flat. The parts are riveted separately on jigs. Then they are swung into place by cranes, thus speeding up erection. Eliminating scaffold work considerably reduces costs.

SPECIAL TRAYS FOR HEAVY CRANK-SHAFTS

MORE than 3,000 specially designed skids or trays are used in the San Leandro, California, plant of The Caterpillar Tractor Company to maintain production schedules and to speed up the in-



Specially designed trays or skids are used to maintain production schedules at The Caterpillar Tractor Company's plant.

ternal transportation of parts and materials. The accompanying photograph shows one that was built to carry 10 crank-shafts. Motive power is supplied by electric trucks with elevating platforms.

This mechanical-handling system is supplemented in some of the shop departments and in the shipping and service department by overhead-crane service, while gasoline tractors are used for car shifting in the yards.

NO MORE SHORT SHIPMENTS

AN unusual application of the use of scales in conjunction with materials-handling systems to count parts and materials is used at the plant of the S. M. Jones Company, Toledo, Ohio, where this dependable factory method has done much to lower handling costs on rods coming either from plant to warehouse or from warehouse to railroad car.

The scales are used here in connection with an overhead conveyor to check the count of sucker rods which, because of their flexibility, are hard to handle. As a result, the company finds that it can load four cars a day instead of three, there is no need of a man to act as checker, and complaints of short shipments have been stopped.

V

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V

ENERGY SAVERS

MECHANICAL HANDLING SAVES THIS PLANT $125,000 A YEAR

WHEN a plant can reduce the costs of its intra-plant movement of product over 60 cents a ton it is making a signal advance in operating efficiency. And when this saving is made on about 200,000 tons of product in the course of a year, the saving represents a considerable item of expense eliminated from the cost sheets.

The Chicago plant of Swift and Company accomplished this saving, and at the same time speeded up its intra-plant material movements, through the installation of an overhead tractor-way, three-quarters of a mile in length, connecting all the manufacturing departments of its plant which spreads over 56 acres of Packingtown.

The installation was completed in December of 1924. During its three years of operation it has realized this saving, which figures out over $125,000 annually. The cost of the installation was about $800,000.

As first planned, it called for an overhead electric tramway, on steel track. This plan was abandoned, however, in favor of the greater flexibility of a system calling for electric tractors and trailers. Now gasoline power units are also being used.

When the equipment was installed, the company was able to dispense with the services of 67 horses and 47 wagons that had been employed entirely in the intra-plant movement of product and materials. It also released for urgent demands of long-distance transportation refrigerator cars sufficient to supply 2,420 refrigerator car-days a year, to augment the capacity of the facilities for inter-plant product movement, and to save $20,000 annually in icing and switching charges for these cars.

A fleet of 15 tractors furnishes the motive power for the entire tractor-way. At least 12 of these are in daily operation, and when they can take care of all freight movement, the others can be diverted to other hauling and loading jobs at the plant. The 15 drivers, 3 dispatchers, 1 janitor, and 1 foreman comprise the entire

personnel of the tractor-way necessary to handle the weekly movement of about 8,000,000 pounds of product. Over 1,300 trailers are in use. About half of these are necessary for actual movement of product—the others are employed to allow loading in advance of delivery time, saving considerable double handling.

The tractor-way is located on approximately the fourth-floor level of all the plant buildings, which average from six to eight stories in height. Along the route is a series of assembly rooms, where trailers are loaded and the tractor-trains made up. Roller and power conveyors bring the product to these assembly points, and from there each trailer load moves as part of a train to its destination.

Each tractor driver has a portion of the route to patrol and keep cleaned up. When the load on any one section slackens, dispatchers reassign the drivers to congested areas. To facilitate movements between floors, five large elevators, each with a cage 40 feet long by 6 feet wide, are located at strategic points. An elevator of this type will accommodate a tractor with a string of four trailers. The tractors can and do handle up to 20 trailers, but when it is necessary to transfer a load from one floor to another, the four-trailer train is the most efficient unit and is generally employed.

Five large elevators are located at strategic points in Swift and Company's Chicago plant to handle tractor-trailer trains between floors.

The manner in which the assembly room works can be illustrated by its operation in the fresh pork department. Here 50% of the product is packed in advance, and held in coolers at from 26 degrees to 28 degrees Fahrenheit until ordered out for shipment. The other 50% is packed and shipped directly from the cutting room. Roller conveyors take this product from either the cooler or the cutting room onto the assembly room power conveyor. Here it is sorted according to destination, and then loaded onto trailers, which are made up into trains for transport to refrigerator docks.

Care is taken in the process to see that the temperature of the product does not rise materially during this handling. The assembly room is kept cool. Transportation to the loading dock takes but a few minutes, and here cooling is taken care of by an ingenious utilization of leakage from adjacent coolers and from the refrigerator cars. Special flexible curtains, covering all doors through which cars are loaded, allow the cold air to escape only into the loading dock, and this alone keeps the temperature always 20 degrees to 30 degrees below the outside air even in midsummer.

Manufacturing departments which do not have a sufficient amount of product to move to call for an assembly room organization load their trailers and spot them on the runway, where they are picked up by the first train bound toward their destination.

Only electric tractors were used in the original installation. Recently, however, newly developed gasoline tractors have been tried out and two of these are now in use.

In addition to effecting a saving of more than 15% of the cost of the original installation in each year of its operation, the tractor-way has accelerated greatly the handling of shipments from the manufacturing plant to branch houses, over the company's car routes, and through other channels. Packingtown is honeycombed with railroad tracks which are in constant use, and these, plus the normal heavy traffic, slowed up teaming transport materially. Now it is possible to receive an order at noon, and have product from a dozen different departments in the far corners of the plant assembled and loaded by 3 p. m.

The tractor-way has also speeded the receiving of raw materials and the transport of machinery, tools, and repair parts needed by the maintenance and repair gangs.

Tractor drivers are paid on an incentive plan.

—James E. Weber in *Factory and Industrial Management*, February, 1928.

PRODUCTION COSTS HALVED

EQUIPMENT primarily intended for quite another purpose, plus a little ingenuity, may often provide the answer to a problem that has long troubled management. A hydraulic jack, for instance, is a familiar bit of equipment for certain types of lifting operations, but one would hardly expect to find it used as a horizontal press to press in bushings. And yet that is just what it may be found doing at the Wisconsin Motor Manufacturing Company, Milwaukee, where the plant superintendent saw one sitting under

A hydraulic jack, adapted to the job of pressing on bushings, cuts costs.

the rear end of a passenger automobile and adapted it—or rather a 7-ton jack like it—to a specific job that had been bothering him.

A mechanical press had formerly been used for this job and often was in bad order, causing costly delays and repairs. Not only that, but the operator had to exert a heavy pull on an overhead handle to secure enough pressure, and was pretty well worn out at the end of a day's work.

The photograph shows how easily the 7-ton jack was installed, supplanting the old equipment. The collars shown on the stand are pressed on the ends of drive shafts, three of which appear in the pic-

ture. Several shafts are also shown with the operation completed.

To help speed up production, a spring is fastened to the base of the jack and to the side of the ram. When the release valve is opened by the operator, this spring pulls the head of the jack off the finished job, making it possible to remove the place and to place a new shaft and collar. The operation is now completed in half the time, the operator works in comfort, and no time is lost on account of the equipment getting out of order.

One man and a helper scales-count 1,500,000 parts daily at Buick Motor Co.

SCALES-COUNTING SAVES ENERGY

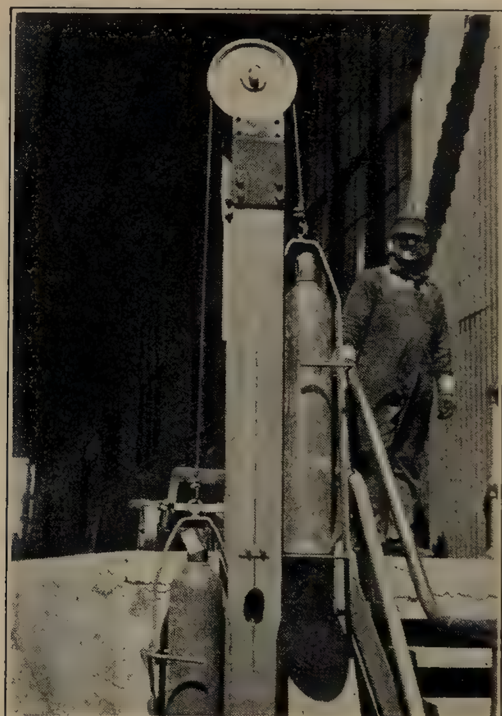
CONTINUOUS activity toward minimizing materials-handling costs within the plant enables the manufacturer to meet competition in his own particular field. Present-day competitive conditions, in fact, make investment in better handling equipment imperative if no opportunities to make money are to be overlooked.

The progress which is being made in this phase of management activity is instanced in the handling practice at the Buick Motor Company, Flint, Michigan.

The photograph shows the speedy method of handling and counting the production of the automatic machine division.

The finished parts are discharged from the machines direct to pans which move through an automatic spiral gravity conveyor to the counting and shipping room on the first floor. Here the parts are transferred to a master pan and are scales-counted, the smaller pieces on a 20 to 1 ratio, the larger pieces on a 50 to 1 ratio.

An automatic air-lift is used to handle the pans. Thus, one man and a helper are able to handle and count the entire output of the division, which is approximately 14 tons or 1,500,000 pieces daily.



With this hoist cylinders are lowered in safety from the receiving platform.

HANDLING CYLINDERS SAFELY

A MINING company which makes extensive use of the oxy-acetylene process has worked out a new and simple hoist by means of which cylinders are handled quickly and carefully.

Previously, full cylinders had been taken from stores as needed and slid on skids from the cement platform of the receiving room to the ground. The cylinders were often damaged by the rough treatment received in this method of handling.

In order to find a safer way to handle these cylinders, a survey was made of odd materials, and with the aid of the plant welder the hoist shown in the photograph was constructed. As a base, a structural H-beam was set rigidly in cement at one end of the platform. To it was attached a pulley large enough so that the wire rope supporting the cages would work clear of the beam flanges and allow the cages to operate without binding on the frame.

The cages were simply constructed from heavy strap-iron with an iron plate welded on the bottom to provide a rest for the cylinder. The job was completed by cutting wire rope to the correct length and fastening it to the cages over the pulley.

The way in which the hoist is used is clear at a glance. First, an empty cylinder is set in the lower cage; then a full one is placed in the upper cage. The difference in weight between the two cylinders, aided by a slight pull, is enough to draw the empty cylinder to the top, and to allow the full one to descend gently to the ground.

In this way rough handling is avoided. The new method is not only safer, but easier and more efficient.

BRINGING THE MACHINE TO THE MATERIAL

IN filling an order for less-than-full-reel lots of telephone cable at the Hawthorne warehouse of the Western Electric Company, it used to be necessary to remove the full reel from storage on the floor and roll it by hand to a rewinding device where the length of cable desired was to be removed and the full reel returned to storage. This work is now considerably simplified.

Now when less-than-full-reel lengths of cable are needed a rewinding and measuring device mounted on wheels is moved from reel to reel as required. This rewinder is a self-contained, motor-driven, storage-battery powered device, and functions anywhere.

Floor space is saved because the reels are stored, one above the other, on racks. The axes of the reels are not, however, in exactly the same vertical plane. The bottom ones are set out slightly beyond the upper. Thus it is possible for a crane to replace empty reels in either upper or lower rows. Since full reels weigh from 800 to 7,000 pounds, a crane is the best method of handling.

Much time and effort are saved by this storage arrangement, and by wheeling the rewinding device to the full reel instead of the reverse order.

One man operates a crane and lifting magnet that conveys steel billets to the loading platform of a continuous heating furnace.

ONE MAN REPLACES FIVE

A "ONE-MAN" outfit has been developed at The Phoenix Iron Company, Phoenixville, Pennsylvania, which does the work of five men with as much speed and accuracy as if those men were actually on the job. One man plays the part of crane operator, lifting magnet operator, and furnace charger.

This outfit consists of an overhead crane that spans the width of the mill, an automatic control board in the power house, a lifting magnet designed to handle steel billets, and a control box with a row of push-buttons which is carried by a strap hung around the neck of the operator. There is also a long steel handle by which he can turn the magnet into any position.

In the center of the building is a continuous heating furnace through which steel billets move slowly as they are heated for the rolling mill. As a hot billet is taken out of the furnace, a cold one is fed in at the other end. And it is this man's job to keep the loading platform filled.

This is the way the outfit works. Near the furnace stands a car-

load of billets brought in from storage. With one hand playing upon the keyboard of the control box which is slung across his chest, and with the other grasping the handle attached to the magnet, the operator walks toward the billets on the car, turning the magnet parallel to their length. When the magnet is over the middle of a billet, he presses a button. The magnet drops and there is the ring of metal as it takes hold. A second pressure and the billet is raised. Four other buttons in pairs control the movements of the crane. The operator backs away with his load, turns, and brings the magnet over the loading platform at the heating furnace, where the billet is dropped next in line.

Eight men, four on each shift, have been dispensed with since the installation of this billet-handling method.

FOUR MEN AND A MAGNET

COILED strip steel is heavy, awkward stuff to handle, but loading it becomes almost child's play with a lifting magnet. The Superior Steel Corporation at Carnegie, Pennsylvania, whose product is largely cold and hot rolled strip, recently loaded 200,000

At the Superior Steel Corporation, strip steel is handled without fear of damage through dropping by placing a thin steel plate over the coils.

pounds into box cars with a magnet and four men during a 10-hour shift, whereas the best six men could load before the magnet was installed was 140,000 pounds in a shift of similar length.

The magnets usually handle two coils at a time, but if the coils are not placed tightly against each other, one or both has a tendency to fall away from the magnet and be held in a vertical position—an unsatisfactory condition since the coils are apt to be battered if dropped on edge.

The Superior Steel Corporation discovered, however, that a thin sheet of steel placed over the coils, as shown in the accompanying photograph, would spread the flux from the magnet sufficiently to hold both coils against the plate. It is a peculiar fact that this plate does not short-circuit the flux, but on the contrary causes the magnet to do a better job than without the plate.

Much of their strip steel is boxed flat, but this does not interfere with its being handled by the magnet in packages that run as high as 1,000 pounds.

THIS TRACTOR PAYS DIVIDENDS

A GASOLINE tractor equipped with a special loader makes short work of cleaning up great piles of broken bricks at the Chicago Brick Company's plant, Riverdale, Illinois. By cutting down handling time and expense the equipment has returned the cost of installation many times.

It also "throws" track, makes roads into the yard and makes grades into the pit for the dinkey railroad. In fact, according to

By cutting down handling time and expense this gasoline tractor equipped with a special loader has returned substantial dividends on the initial investment.

James McLaughlin, Superintendent, it does "almost anything, anywhere, any time."

The truck body can be raised 11½ feet, saving both time and labor in piling wood in high stacks.

PILING WOOD MADE EASY

AN enterprising Seattle wood dealer designed and built the elevating truck body shown in the illustration. It saves time and labor in piling wood in high stacks. The elevating body can lift 2 cords of wood to a height of nearly 12 feet, providing a platform from which the wood can be easily transferred to the top of the pile. It is said to be the only truck with an elevating body that remains absolutely level when raised.

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VI

MATERIAL SAVERS

SALVAGING SOILED CLOTHS

THE Syracuse Washing Machine Corporation, Syracuse, New York, saves more than $6,000 annually by washing soiled wiping and polishing cloths that are used in its own factory. Four washing-machines, with one attendant, do the work that makes this economy possible.

Prior to the installation of the present system, all cloths were discarded as soon as they became soiled, a monthly average of eight bales weighing about 700 pounds apiece. At a cost of 14 to 15 cents a pound, this represented a yearly expenditure of about $9,700. Now rag consumption has dropped to an average of 2½ bales a month, costing approximately $3,000 annually. Special check-ups show that some of these rags have been washed and reused 16 times, while better-grade wipers have been washed and reissued as many as 40 times and look good for 40 more washings.

Wash-room towels and hospital uniforms were formerly sent to a commercial laundry at a cost of $900 a year. Now these pieces are also laundered in the factory. The total saving is therefore $7,600; total washing cost, including depreciation on machines, labor, gas, and floor space, $1,155; net saving, $6,445.

Each of the four washing-machines handles an average daily wash of six loads of cloths, each load representing about 10 pounds of dry cloths. Most of the loads have to be washed twice, due to the dirty condition of the rags, so each day's work usually means about 11 separate washings for each machine. From 25 to 35 minutes is allowed for each washing, depending on the condition of the cloths.

A centrifugal drying tub on each machine is used to extract the water from the cloths preparatory to hanging them on the line. The cloths are then hung on wires strung on steel racks, and for the final drying these racks are rolled into baking ovens—obsolete ovens formerly used for japanning—and the cloths are subjected to a heat of 250 degrees Fahrenheit for about 30 minutes. When taken

More than $6,000 is saved annually at the Syracuse Washing Machine Corporation, Syracuse, New York, by washing and reusing soiled cloths.

from the oven the cloths are clean, dry, and ready for reissue to the workmen.

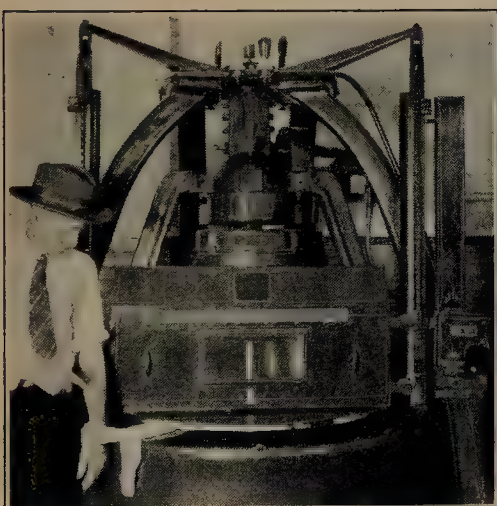
Over and above the economy of using the same rags over and over, this system has other advantages. For one thing, better rags can be used. They are more pleasant to work with, and the workmen can keep themselves and their machines in better condition. Then, too, the use of better rags in wiping and polishing machines when they come from the inspection rooms gives superior results in the final preparations for shipment.

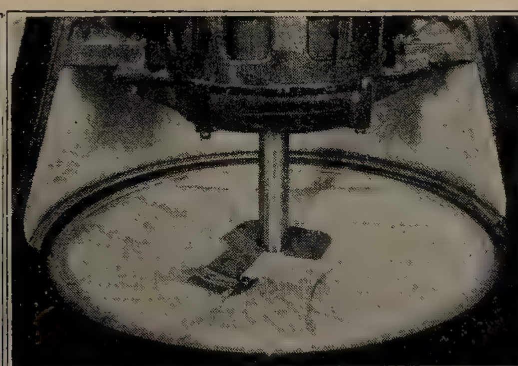
AVOIDING RIP-SAW WASTES

MANY a box-shop swing-saw and rip-saw operator uses a method of ripping lumber to width that causes an excessive waste. Let us say he has cut his pieces to length on the swing-saw,

and that the width of the plank is 6¾ inches. Suppose he wants to rip for a box side that is 11 inches wide or high. What he may do is this: he sets his rip-guide 5½ inches from the circular saw, and rips two lengths (each 6¾ inches wide) to that set width. These two lengths, side by side, make the required 11-inch width. Incidentally, there is a 1¼-inch wastage from each piece. In such a shop you will find a great deal of waste lumber between one and two inches in width.

There is a simple way to avoid this waste. Set the rip-guide 11 inches from the saw. Shove the two 6¾-inch widths through at once, side by side. You then have two pieces making an 11-inch width, and an extra piece of a 2½-inch width (2 x 6¾ minus 11 equals 2½). This extra piece shoved through the saw with two other 6¾-inch pieces will leave a 5-inch-wide piece—which can then be used with another regular width, leaving only a half-inch waste at the end after three side widths have been ripped. By the other method of saving the waste from three side widths would be 7½ inches.





In laundering linens, a canvas cover prevents pieces from flying out and being torn.

SAFETY IN LAUNDERING

A COVER which promotes safety in laundering linens is in use at the Pullman Works of Pullman Company, Chicago. It prevents accidents to operators caused by pieces of linen flying out of the extractor basket while in motion.

This cover is made of heavy canvas to which has been riveted a collar of leather, there being a piece of leather on each side of the

canvas forming the collar. The split portion of the collar is hooked together by a ring catch to prevent spreading while in centrifugal motion. When covered, the top of the basket is smooth and the load is safe. Loads do not have to be adjusted after the machine has been put into operation. Without the cover, the load tends to creep up the spindle or the edges of the basket. And it is entirely possible for a piece of linen to fly out and wrap itself around a man's arm, as a result breaking the arm.

This safety device is also an economical investment, for when a piece of linen does fly out of the basket it is usually whipped to pieces before the machine can be stopped.

BATCHES MIXED ECONOMICALLY

HOW best to weigh and handle materials becomes a problem of major importance in any plant where large quantities in bulk enter into the making of the product. The glass industry, for example, uses among other ingredients silica, soda ash and lime in exact proportions, and when these various ingredients can be handled with a minimum of waste motion, gratifying savings are often the result.

At the Owens Bottle Company, Charleston, West Virginia, auto-

Automatic scales installed under bin hoppers in the mixing tunnel make it a simple procedure to weigh out batches of the proper consistency.

matic scales are installed along a runway, and make it a simple matter to weigh out batches of the proper consistency. The various materials are stored in bins situated directly over the scales hoppers, and as a car moves through the mixing tunnel the required amount of each ingredient is dumped into the hopper, weighed and dropped into the waiting car.

With this arrangement correctly proportioned batches are put together quickly and without incurring unnecessary handling expense.

Pouring from the bottom lessens the danger of spilling hot metal.

BOTTOM-POUR LADLE PROTECTS OPERATOR

POURING from the bottom—not from the top—the ladle shown here in use in the plant of the Manitowoc Shipbuilding Corporation at Manitowoc, Wisconsin, protects the operator from the danger of serious burns so often caused by hot metal being thrown against the clothing when using the conventional wet skimmer or ladle. Moreover, to protect the hands from burning due to an overheated handle, a sliding sleeve is provided, enabling the worker to grasp the handle safely.

The ladle has further advantages. It is self-skimming, which insures clean metal, prevents metal wastes, and saves time and labor

ordinarily required in skimming the slag from the metal which is being poured.

The illustration shows two operators pouring babbitt in the stern bearing sleeve of the propeller shaft of a car ferry.

WASHERS FROM BEER-KEG HOOPS

THE treasurer of the Alamo Iron Works, San Antonio, Texas, recently hit upon the economical idea of turning perfectly useless beer-keg hoops into perfectly good cut-steel washers. This company maintains a large scrap-yard equipped with machinery to handle and salvage all kinds of metal. A large quantity of the hoops came into the company's possession as a result of prohibition activities. The plan resolved upon suggests a good method of turning many kinds of waste pieces of sheet metal to advantageous use.

The process is simple. First the riveted lap, about six inches long and containing two quarter-inch rivets, is cut out. The hoop then goes to the straightening machine, which consists of two smooth rolls with a grooved guide in front of them. Since the hoop has a variable diameter it comes from the rolls a warped, curved band. From the straightener the band is taken to a punch press and fed through by hand, the ragged strip left in the operator's hand going

The straightening machine in the salvaging plant of the Alamo Iron Works consists of two smooth rolls from which the hoop emerges a curved, warped band.

to join the riveted lap among the sash-weight materials at the foundry.

The washers and punchings from their centers are dumped into a tumbling barrel, rattled about to remove the burrs, and then placed on a perforated steel plate. The operator moves them to and fro. The washers remain on the plate; the punchings fall through the holes and go to make more sash-weights.

A skip hoist with magnet attached handles 20 tons of scrap steel hourly.

HANDLING SCRAP CHEAPLY WITH A MAGNET

SCRAP handling and disposal presents a very real problem in many manufacturing plants and often calls for the exercise of management ingenuity. That it can be handled economically is evidenced in the photograph taken at the Harrington and King Perforating Company's plant in Chicago, where an ordinary skip hoist, on which the skip has been replaced by a magnet, handles 20 tons of scrap steel an hour.

Steel scrap, which is turned out by nearly every production machine in the factory, is carried as it accumulates to a 400-ton storage

bin located beneath the floor level at one end of the main building. To load the scrap into gondola-cars spotted just outside the building, a magnet is suspended from a 45-degree track running from the bin to a chute over the car.

To operate, the magnet is lowered until it rests on the scrap, the magnetizing current is turned on, and it picks up a load. The magnet is then run to the loading chute where the power is shut off and the load dropped. To cut down the power needed, the magnet is balanced by a counter-weight which moves in the opposite direction.

Running 62 trips an hour, the magnet averages 650 pounds per lift. Not only does it cut handling costs, but, by delivering the scrap to the car instead of in the yards, the company is able to get an additional $2 a ton.

WE SALVAGE $10,000 A MONTH FROM INCOMING SCRAP LUMBER

WE used to sell our scrap packing lumber for a dollar a load, and felt we were doing well to get rid of it so easily. The contractor drove into the plant, loaded his wagons just as full as he could get them, and carted the stuff away.

A few years ago, though, we began to wonder whether it might not be possible to reclaim some of this lumber. There were great quantities coming in—though, I daresay, what we get is not as much in proportion to the size of our plant as it would be if we were engaged in an industry which did not get the bulk of its materials in the form of bar and sheet steel.

So, in a little corner of unused factory space, we set up two or three wood-working machines of the simplest sort: a couple of saws and a planer. With this equipment we began to work over some of the more obviously valuable pieces of lumber which came to us as car-bracing, packing crates, and the like.

Today this plant has grown to about a dozen pieces of woodworking machinery, although it is still housed in an inexpensive building. To this building comes all of the lumber which would otherwise be thrown away. Regular crews and tractors and trucks are assigned to the job of cleaning up the yard of all this sort of thing. They go to the tracks where cars are unloaded and pick up such lumber as the 2-inch planks which are used, nailed together to double thickness, as staging to which engines are bolted to ship

them from the engine plant at Pontiac. All odds and ends of lumber are picked up and hauled to the saw-mill, ½-inch material or less excepted. This light lumber, we have learned by sad experience, is not worth putting much effort on.

This material we work up into many kinds of lumber for our own use in shipping. Shiplap for export cases is one of our major products. Two-by-fours for bracing, two-by-sixes, anything we can get out of the scrap that will be useful around the plant is grist to our saw-mill. Occasionally we have a surplus to sell outside.

Of course it is necessary to do some work in preparing the material for use. Boards have to be pried apart, nails pulled out, all that sort of thing done. The workmen are all paid on piece-rates per thousand board feet.

Just the other day I "sold" an order of 100,000 board feet to the export packing department. This order is for two-by-six braces about five feet long, diagonally rabbeted to serve as inside braces for export cases. They had been paying $45 a thousand for the lumber, then spending about $5 more to unload it and rabbet it out. We do the job at a cost to the saw-mill of $3.50 a thousand, and are credited by a bookkeeping entry of $25 a thousand feet turned over to export packing. The estimated saving to the company—disregarding the bookkeeping entries and all that sort of thing—is $2,000 monthly on this item of inside case bracing alone.

Besides these larger items such as bracing and shiplap, the mill turns out a world of smaller stuff. It produces two-by-four bevels for car blocking of automobiles for domestic shipment, small dunnage, even box-ends. The smallest scraps are fastened together with corrugated metal fasteners for box-ends.

Altogether, disregarding the bookkeeping entries, we figure that this lumber reclamation activity saves the company more than $200,000 a year over and above all the expense of reclaiming and the price formerly received from wood dealers. On the corporate books, the saw-mill is credited with net earnings of about $125,000 a year in the price it "sells" for, minus the costs deductible.

—F. L. St. John in *Factory*, September, 1927.

DOUBLE SERVICE THROUGH SIMPLE RECLAMATION

UNTIL about two years ago, the Revere Sugar Refinery, Boston, used its sugar bags only once, and then disposed of them as second-hand bags. Now the bags are mended, and again sent to

Cuba for use. Two uses of the bags are at present about the limit of economy, but three times is being attained with some bags, and the company hopes to secure an average of three uses.

Immediately after a bag of sugar is dumped into the first hopper for processing, the bag is turned inside out and put in a brushing machine which brushes out all loose sugar. The bag then goes to the sewing room where all holes are mended. About 40% of the bags received can be used over again.

The women in the sewing room received $15 a week at the start of the system of reclaiming the bags, but since this work is now on a bonus plan, some of the women at times make as much as $36 a week.

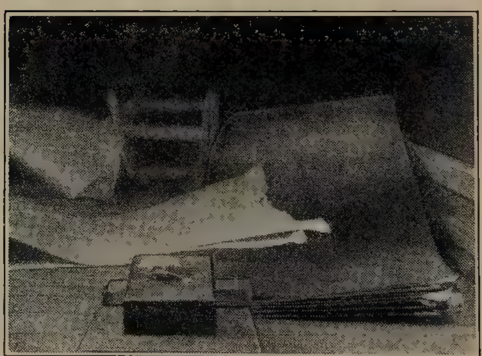
A good worker can mend about a ton of bags a day, with about 900 empty bags to a ton. During the first year, the mending cost averaged 1.2 cents a bag, and since then has been about 0.7 cents, a reduction in cost of approximately 40%.

As a second-hand bag is worth only 12 cents, and a new bag costs 25 cents, it is readily apparent that there is an important saving made on the scores of shiploads which the company handles every year.

LESS DAMAGE IN TRANSIT

LOADING and bracing heavy manufactured products in box-cars has always presented great difficulties. And with higher train speeds and the increasing use of gravity yards, the hazards have been increased, making advisable the development of improved methods of securing materials in cars.

The American Railway Association has, from time to time, modified its loading rules, yet from figures supplied by the Chesapeake



After four impacts this happened to sheets braced in the old way.

In the opposite end of the car, showing effectiveness of the new method.

and Ohio Railroad, it was shown recently that out of 348 cars loaded by their rules, 39% arrived at destination in damaged condition, while 29 cars had ends or door posts knocked out.

In an effort to remedy such conditions, therefore, the American Rolling Mill Company of Middletown, Ohio, began in 1926 a series of experiments with high-finished oiled sheet iron which resulted in discarding the rigid blocking principle. Their engineers turned logically to their own resources, as it were, and after making a package of sheets used steel strips as binders.

Early experiments proved this method to be about 75% efficient, but a slight change in the material used as a reinforcing band brought efficiency up to nearly 98%. Since June, 1927, in fact, no failure has been reported on shipments made from the Ashland plant, and only one or two from the Middletown plant. During the entire course of experiments, no damage to railroad equipment has been reported, and total claims on lading damage amounted to about 80 sheets.

The illustrations are self-explanatory. The right hand picture shows the effectiveness of the new method as against the old method pictured on the left. Both photographs were taken in opposite ends of the same car, after the car had been given four impacts.

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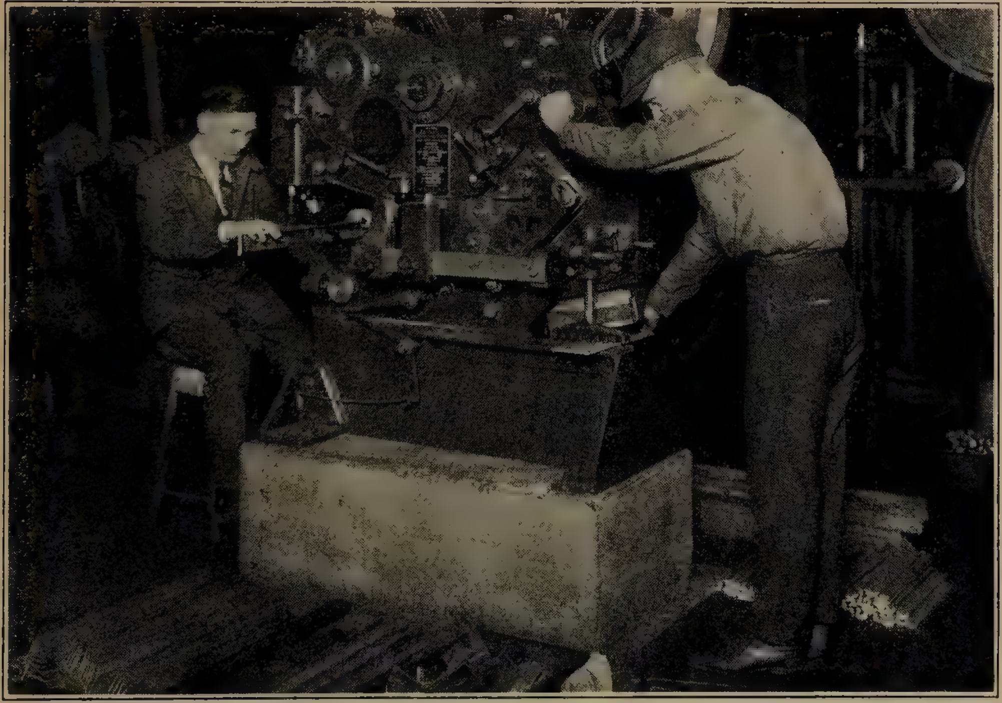
VII

TIME SAVERS

FOUR MACHINES IN ONE

IN SHOPS having a variety of punching, cutting off and shearing operations, an all-purpose machine like the one installed at Kent-Owens Machine Company, Toledo, Ohio, may be made to pay for itself in its first year. This machine has four principal tools as shown in the accompanying photograph—a punch at the left, a section cutter near the middle, a bar cutter immediately adjoining, and shearing knives at the right. The mechanism is such that the punch may be used at the same time as any one of the other tools. In other words, two operators may be working at the machine simultaneously without interfering with each other.

The machine is located in that part of the plant devoted to the



Two men may work simultaneously at this all-purpose machine with its four principal tools. A surprising quantity of sections are routed to it.

manufacture of special machinery where most of the work is done on machine tools. Yet, although a relatively small part of the work can be done on a machine of this nature, it was found after installation that a surprising quantity of sections—bars, flats and other shapes—were directed to it for punching, cutting off, and other operations.

Of course, there are on the market single-purpose units which would do all the operations performed on this machine, but their first cost—for the four machines—would be higher, and the handling costs in moving from one unit to another would form a considerable item of production expense.

AN INDUSTRIAL "POST-OFFICE"

SIXTY-EIGHT employees of the General File and Mailing Division of the Westinghouse Electric and Manufacturing Company handle on an average of 66,900 pieces daily.

Distribution and collections are made by four methods: pneumatic tube, girl messengers, tricycle messengers, and special messengers.

The pneumatic tube system, which has one main station and ten sub-stations, is used for the transportation throughout the East Pittsburgh works of messages of light weight requiring speedy delivery.

Four tricycles ridden by girl operators are in constant operation. One emergency tricycle is kept in readiness for use in case of a breakdown or other emergency.

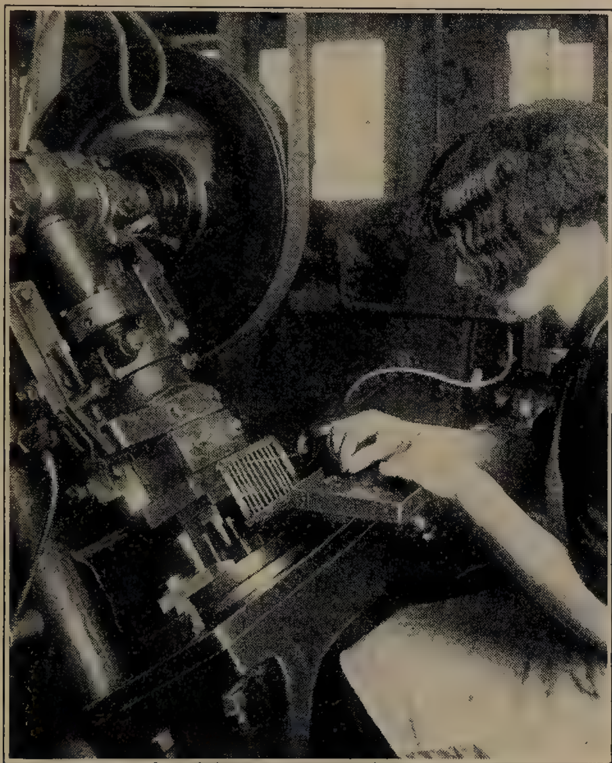
These tricycles have a sheet-metal sorting box which has 22 small and 3 large compartments, each having a metal label. The lower portion of the box is divided into 2 large compartments, for packages and long rolls of blue-prints which are too large to be handled in an upper compartment. When these compartments are used a bright-colored card is placed in the smaller compartments above, marked to show what packages are below, thus serving as a reminder to the operator.

In the bins attached to these tricycles are carried blue-prints, unfolded letters, samples of small size, bound books, magazines, and rush order deliveries of such articles as wire, sample armature coils, and many other small parts.

Mail for the District and Branch offices is combined in one or

more 10 by 13-inch envelopes in order to save postage and envelope expense. This same combination is made with mail for outsiders, but smaller envelopes are used.

Approximately 30% of the inbound mail from outsiders is properly addressed to individuals and departments. The rest of the mail has to be carefully read, addressed to the proper department, and correctly routed.



This gravity feed for feather-weight parts insures safe operation and increases production.

GRAVITY FEED CUTS COSTS

AIMING at safety and ending up with a 59% increase in production is the experience at Automatic Electric, Incorporated, Chicago, where a gravity feed is used on extremely light press-work. That the part fed is a fuse spring running about 700 pieces to the pound provides an answer to the statement so often made that gravity feeds are not successful on light work.

Prior to placing a chute on this die, the parts were placed in the nest by hand and safety handles were used to trip the press. Now

the parts are placed in the pan attached to the slide, and as the press is tipped the pan is horizontal. Parts are fed into the chute, sliding by gravity into the nest of the die. The press is tripped by foot, and compressed air removes the parts after the operation.

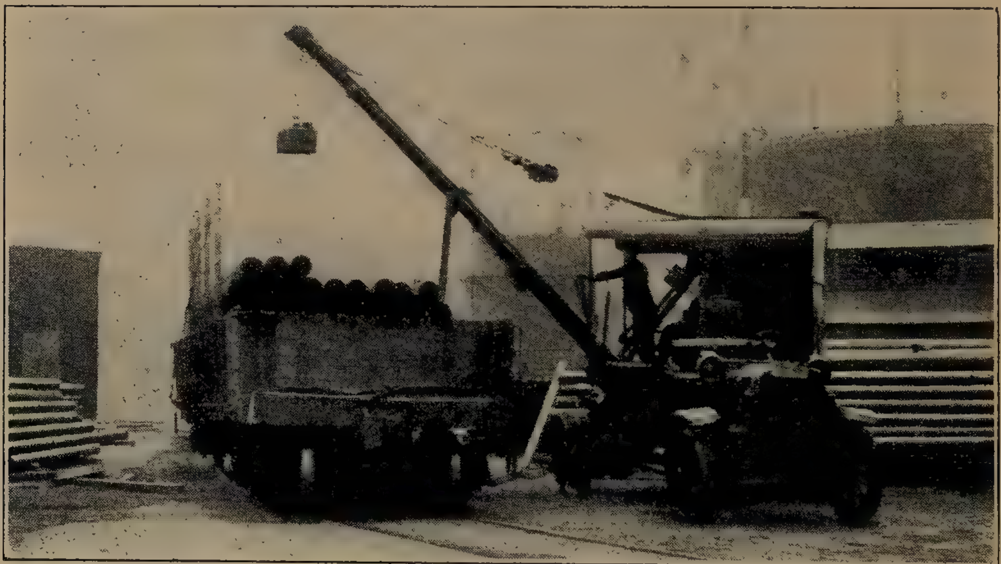
There you are—a feather-weight piece, gravity feed, complete safety, and a 59% production increase.

MOBILE UNIT SPEEDS HANDLING

A 60% increase in unloading speeds was obtained at the East Ohio Gas Company, Cleveland, by changing from hook-block to magnet in handling pipe. The loading, unloading, stacking and rehandling of pipe is all done at this plant by means of a crane mounted on a 5-ton truck.

Unloading speeds vary from three hours per car on 1½-inch pipe to one hour per car on pipe running 10 inches and over. Not only that, but they get along with two less men in handling small sizes and four less men in unloading 6- to 18-inch pipe. And they find that there is less spoilage due to ruining the threads or warping.

Another advantage of this mobile handling unit is the fact that, while it operates normally in one yard, it can be rushed at full truck speeds to other yards of the company where from time to time emergency jobs require its use.



A crane mounted on a 5-ton truck cuts handling time and provides a mobile unit that can be rushed to emergency jobs in other yards of the company.

HANDLING SPEED INCREASED

FACTORY managers are always on the *qui vive* to cut handling costs and speed up handling operations, but are none the less apt to overlook some of the more obvious opportunities to save handling expense that exist in practically every plant.

Tote-boxes, for instance, are relatively small in size, but uncommonly heavy when loaded with stampings from a punch press. They may be dragged across the floor from one operation to another, but

This truck with its sharp nose and platform roller enables a workman to handle heavy cases with ease.

handling becomes much simpler when a small utility truck like the one pictured is used.

This truck has a steel nose that may be inserted under the edge of the object to be moved, and the loading operation is completed by sliding the box over the rollers which are built into the truck platform.

Similarly, the truck may be used as in the illustration to move boxes of merchandise that are too heavy to be lifted on the regular four-wheeled factory truck, and which cannot be handled conveniently with the ordinary two-wheeled hand truck.

The Toy Tinkers of Evanston use this ingenious clamp to obtain a better grip and with less chance of damage to the surfaces gripped.

THIS CLAMP ACTS QUICKLY

AN ingenious clamp is used in the shops of the Toy Tinkers of Evanston. Instead of turning a long screw slowly up to the required position as in the ordinary screw-clamp, by a simple, patented device a half-turn of the square block near the screw-handles releases the screw-bushings, permitting the jaws to be moved quickly into position, after which a few turns of the screw apply a pressure fully equal to that obtainable with the usual clamp. The jaws are as easily released when the job is finished. It will be noted that as the jaws are opened to take larger work, the average of the applied pressure increases.

A better grip is also obtained on the work, and with less possibility of damage to the surfaces gripped. The pivoted jaw adjusts itself automatically to the work, and there is no possibility of rolling or movement of the jaws as the clamp is screwed up. The absence of projecting parts also makes it possible to use the clamps in close corners and out-of-the-way places and is a great help to production.

The clamp is also well fitted to take the punishment to which such small, loose tools are subjected in the average shop. The screw-threads are much less exposed and the screw-rods are secured at

both ends, lessening the chance of their being bent. The rugged, pressed-steel frame of the clamp and its reinforced construction give it great rigidity. The threaded bronze bushings may be replaced if necessary; their design is also such that, as the bushing wears in service, the thread acts as a tap, simply cutting deeper and changing the angle of engagement of the bushing slightly, without introducing any looseness or play.

MAIL DELIVERY EXPEDITED

BECAUSE the men in the superintendent's office at the Chicago plant of Swift and Company spend the greater part of their time out in the plant, the mail desk is located near the entrance where each man has to pass it many times a day. As a man enters or leaves the office, it becomes second nature to look into his own particular pigeonhole and take out the contents, if any. In that way the distribution of mail is facilitated and prompt attention to inter-departmental correspondence is assured.

Pneumatic tubes deliver the mail to the other side of the desk where a boy sorts it directly into the various compartments. The

Near the door, where the men pass it many times daily, an ingeniously constructed desk speeds up mail delivery at the Chicago plant of Swift and Co.

floor of each compartment is pitched forward so that mail can be removed easily and with no chance of leaving any behind. Trap-doors prevent correspondence from sliding out when the boy "shoots" it in from the other side.

LESS TIME LOST IN STARTING

FROM Monday morning to Saturday night, the Revere Sugar Refining Company, Boston, Massachusetts, operates 24 hours a day, with 3 shifts in most departments. Occasionally, if demand for refined sugar is very light, it closes down on Saturdays.

Obviously the most expensive moments of manufacture come in starting up or shutting down. So a good deal of attention has been put into precautions for getting the plant quickly started every Monday morning and tuned up at the earliest possible hour to full capacity.

Important preparations toward quick starting on Monday morning are made during the shut-down on the previous Saturday or Friday night. Immediately after the shut-down all machines are cleaned. Where there is sirup flowing, it is all washed out before it has time to solidify around the moving parts of the mechanism. Cleaning can be done in a few minutes on Saturday night that would take much more time on Monday morning when the mill is cold and processes have not yet reached their pace. Every man before he leaves for the week is required to put his job in condition for an instant pickup.

TELL-TALE LIGHT REDUCES IDLE TIME

AT the plant of the Cincinnati Milling Machine Company a new system has just been installed which greatly reduces idle time resulting from machine breakdowns or material delays.

A green light at the desk of the timekeeper in each department flashes whenever there is any idle time in his department. Idle time may come from a number of causes—the men may be waiting for the foreman to give instructions regarding a job, waiting for material, waiting for jigs or fixtures to come from the tool storage, or waiting for cutters and tools with which to do a job. Machine breakdowns are also causes of delay.

The green light is placed high above the timekeeper's desk and can be seen from any part of the department, so that the foreman of the department can be reached quickly. This green light is a

signal for him to come to the timekeeper's desk immediately to find out the nature of the idle time and to act at once to remedy it. The timekeeper is promptly notified of any idleness in his department by the individual machine operator, as each operator is interested in seeing to it that his machine is working at the full capacity, for he is paid according to his production, and naturally is interested in increasing his weekly earnings.

Although the foreman could usually be called under the old system, it was sometimes difficult to locate him, and frequently the operator had to leave his machine and go through the department looking for the foreman. Under the new system, the foreman promptly responds to the flash of the light, and the idle operator can be put to work preparing for the next job, or doing other productive work rather than simply walking around looking for his foreman.

The men like the system for they get immediate attention. The foremen of the departments like it for they are now able to show a better record of production from their departments and to increase their efficiency and their output.

A MEASURING DEVICE THAT SAVES TIME

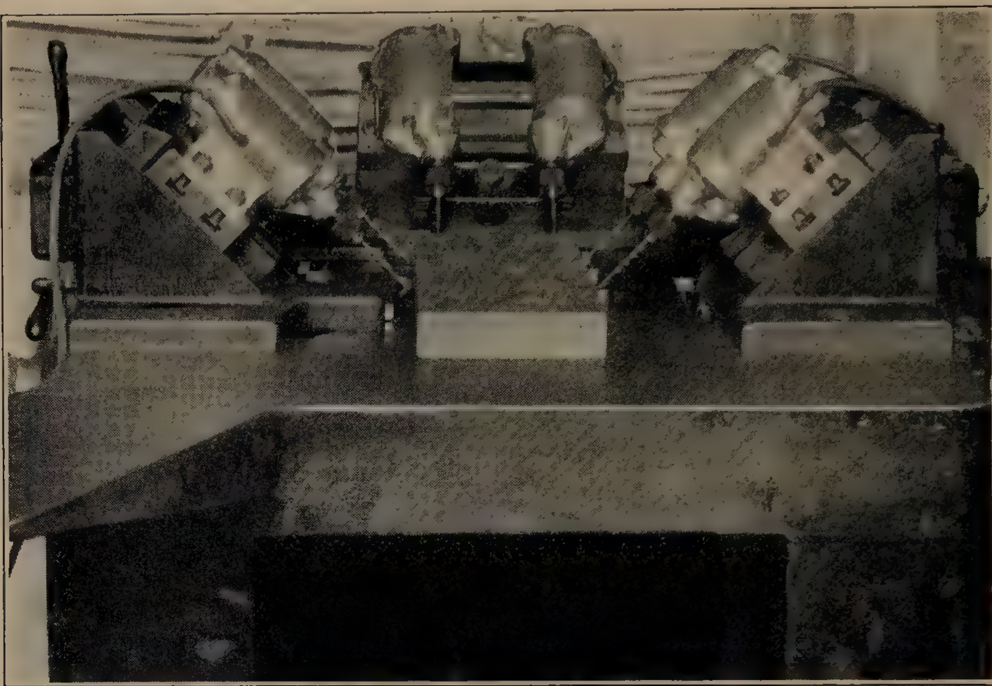
TOOL steel is, of course, sold or issued on requisition by accurate measurement. As it is heavy, considerable needless effort is therefore expended by the stock-room man when a piece just a little shorter than that called for is taken down from the vertical storage rack and has to be returned for a longer piece.

To overcome this waste of time and labor at the Chicago plant of Joseph T. Ryerson and Son, Inc., a scale is painted on one of the building pillars near the stock rack. With this simple device the stock man has merely to stand a piece against this scale as a rough guide before lowering it for more exact measurement and the cut-off operation.

Simple—yes, but a great time and muscle saver.

DRILLING SIX HOLES AT A TIME

THE block-drilling machine shown in the figure is in reality a simple set-up of six electric drills which bore six holes at one time in wood blocks used to brace the wheels of automobiles when packed for shipment. The end of the block that is placed against the tire is not drilled.



The six electric drills in this multiple set-up drill enough blocks in one minute to brace 5 automobiles when loaded—enough in an hour for 300 cars.

The six units are controlled with a single switch. The slide-head blocks into which the drills are fitted can be operated at the desired speed by the feed gears in the base. The machine is designed for continuous 10-hour-day service and, depending upon the speed at which it is operated, has a capacity ranging from 15 to 20 blocks a minute. It drills from 900 to 1,200 blocks an hour.

If the drills are run at high speed, they can bore enough blocks in one minute to brace 5 automobiles—enough in an hour for 300 cars.

SPEEDING UP "SMALL-LOT" SELECTION

THE selection of less-than-full-spool lots of switchboard wire can be a slow process if each spool must be searched out in a rack, removed to a respooling device, and then put back in its place in the rack.

But this kind of work was speeded up at the Western Electric Company's Hawthorne warehouse by the use of an ingenious device. It consists of a rack on which is suspended one spool of each kind of wire, and a bench on which is mounted a frame, and a motor on a pair of rails. An end of the wire from each spool is

drawn through an eyelet in the frame at the rear of the bench and attached to a hook. Under each hook is a label indicating the particular code number.

When a length of wire is specified on an order, the end of that wire is detached, threaded through the measuring device, and attached to an empty spool mounted on the motor, which can be lined up with each spool on the rack, and the wire quickly run off.

A conveyor runs directly behind the operator, and items, as selected, can easily be placed in tote-pans and dispatched to the packers.

VIII

MAKING THE PRODUCT BETTER AND MORE SALABLE

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VIII

MAKING THE PRODUCT BETTER AND MORE SALABLE

TAKING THE HUMAN EQUATION OUT OF INSPECTION

VISUAL inspection of finished parts, however carefully made, is attended by the possibility of error, and wherever possible may well be supplanted by a testing device which leaves nothing to chance and which eliminates the human equation.

How inspection can be made 100% reliable is illustrated in the experience at the Westinghouse Electric and Manufacturing Company, Mansfield, Ohio, where each disc thermostat manufactured for use in automatic irons must be tested to determine whether or not it will open a direct current circuit without drawing an arc at the contacts. Until recently, visual inspection was the method used to determine this, and the old test rig consisted of a number of heater bricks, each carrying above it contacts into which the thermostats were placed. One man attended four bricks, laying aside thermostats which he saw arc as they opened.

Now, the visual method has been supplanted by a testing device built around a wattmeter which measures the power loss in the contacts, and which, on deflection, trips an alarm circuit. As each thermostat is tested, the apparatus moves the next one automatically into position. All that is required of the operator is to place the thermostats in position and remove them, throwing out defective ones when the alarm rings.

If a thermostat does not open quickly enough to break the circuit almost instantaneously, thus causing the direct current passing through it to arc across its contacts, the power loss deflects the wattmeter. The movement of the latter is so connected that a circuit is instantly closed which rings the alarm bell and cuts off the power to save the silver contacts from burning. It is interesting to note that the operations of the tester are functions of the electrical conditions at the testing contacts, and that no cams, ratchets or other complicated mechanical contrivances are necessary.

The advantages of this testing device are obvious. First of all, it eliminates the human element in testing the thermostats for arcing,

No chance for human error with this device for testing disc thermostats used in automatic irons.

insuring reliability of the finished product. More than that, the new method is faster, the arc does not flash in the operator's eyes, less power is consumed and the silver contacts of thermostats which arc are protected.

ONE USE FOR ELECTRIC HEAT IN THE SHOE INDUSTRY

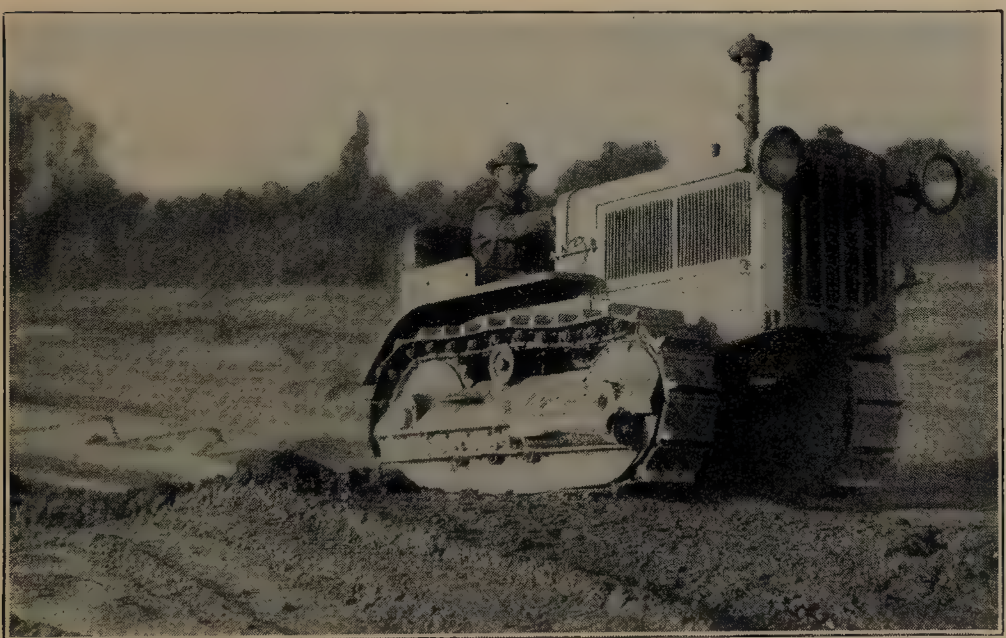
THE shoe-manufacturing industry is replete with examples of the unusual in the applications of electric energy and particularly in the economical use of electric heat. One of the latest is the use of electric ovens for baking enamel on shoe eyelets. An installation

of three japanning ovens with automatic temperature control, in the plant of the Atlas Tack Corporation, Fairhaven, Massachusetts, has under working conditions given greater output than seven steam-heated ovens, which the japanning ovens have supplanted.

The eyelets, which are punched out of brass sheeting, are dipped in japan and are fastened on cardboard sheets. They are subsequently sprayed with four to six coats of enamel, each coat being baked for two hours. The electric ovens operate at temperatures of from 270 to 350 degrees Fahrenheit—the average operating temperature is 285 degrees—and the automatic control maintains the temperature within a maximum variation of 1%. A free circulation of air through the heaters is maintained by a 3-horse-power blower and the individual heaters draw some 36 kilowatts at full load, though consuming on the average somewhat less than 30 kilowatts.

PROVING GROUNDS CHECK TRACTOR PERFORMANCE

PROVING grounds have long since demonstrated their worth in the automotive field, so it is only logical to find the idea adapted by a tractor manufacturer to fit his own set of production problems. The accompanying figure shows a new model being put through a



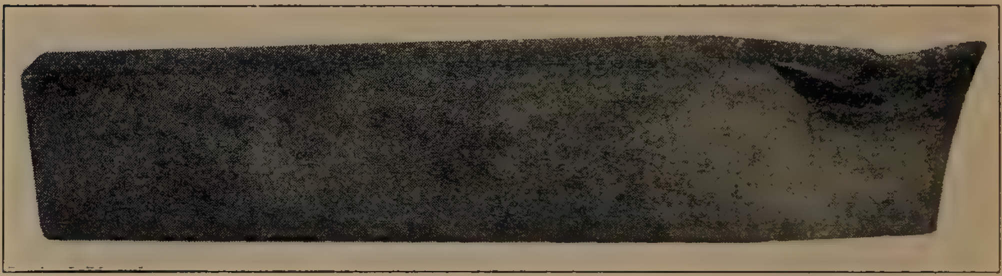
By testing tractors under capacity loads at this proving ground, performance can be checked before production actually begins.

series of gruelling tests on the proving grounds at the Caterpillar Tractor Company at San Leandro, California.

Day and night for six months this tractor was run with a capacity load dragged on a long steel boat. Thus, the engineers were able, before production began, to check performance under conditions simulating as closely as possible those encountered during actual operation.

BETTER LATHE TOOLS

HIGH-SPEED tools are usually made by welding a block of self-hardening tool steel to an ordinary mild steel shank. Obviously, when two flat surfaces are fused together the joint is apt to be the weakest part of the tool. Furthermore, heat is not readily



The point of this lathe tool has been built up by fusing successive drops of molten metal from a self-hardening tool-steel electrode.

conducted away from the point, and an unnecessarily hot cutting edge is the result.

The illustration shows a lathe tool in which the point has been built up by fusing successive drops of molten metal from a self-hardening tool-steel electrode. There is no weak spot in this tool, for the high-speed point is integral with the shank. And since there is no joint, the heat is conducted away from the point more readily.

THE X-RAY GOES TO WORK IN THE FACTORY

THE X-ray, a comparative newcomer in the industrial field, is now finding many new uses in manufacturing plants. It is known that the X-ray will reveal defects in castings, and government scientists have proved that it will disclose cracks, bad welds, gas pockets due to imperfectly oxidized metal, and sand and gas pockets caused by loose dirt in molds. Another application of the X-ray is in the detection of the substitution of one metal for another.

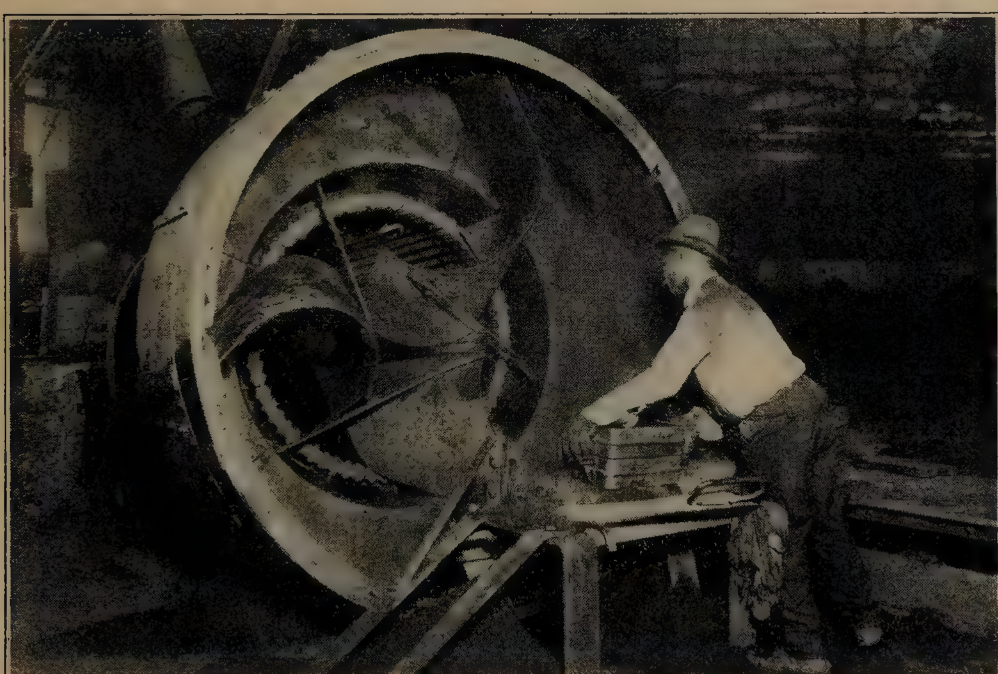
Carbon steel, for instance, can be distinguished from tungsten. The X-ray will also reveal defective soldering, priming, and corrosion.

The wood-using industries also afford a field for the use of the X-ray, for it will reveal defects in wood which only a timber expert could detect by external inspection. It has been found, too, that articles manufactured from fiber, phenol resins, and other substances of low density and containing little or no matter of heavy atomic weight can be successfully examined by the X-ray.

HELPS PUT JOB FOUNDING ON PRODUCTION BASIS

USED in conjunction with a revolving molding and pouring platform in the foundry of French and Hecht, Davenport, Iowa, a tumbling barrel plays its part in putting job founding on a production basis.

After the molds leave the pourers, the top weights are removed and a moment later they reach the dumping barrel. If the mold is large and the iron has not had time to "set," it is allowed to remain on the turntable during a complete revolution. If it is small, it is taken from the table at once and dumped upside down on a tray



After the mold has been dumped, the tray is tilted and the curved sections of the tumbling barrel pick up both sand and casting.

which is tilted so that sand and casting are picked up by the curved sections and carried into the main body of the barrel.

The barrel is, in effect, a circular iron grating. The casting is rattled around in the barrel, breaking off the gate and fins and knocking loose the sand which falls through the grating into the hopper below. Meanwhile the casting is working toward the end and finally tumbles out, practically clean, into a chute leading to the rattling room on the first floor.

As many as 3,000 radio receiving sets are balanced and tested daily by the 51 workers in this conveyor-equipped "English roundhouse."

CONVEYORS SPEED UP TESTING

AN INNOVATION in the radio industry is seen in the installation by the Crosley Radio Corporation, Cincinnati, Ohio, of an oblong booth equipped with two belt conveyors for the balancing and testing of radio sets. An unusual feature of this booth is the fact that it has replaceable test tables for each worker with conveyors running behind them. It accommodates 51 employees who handle as many as 3,000 sets a day.

Because of its appearance the booth has been dubbed "the English roundhouse." Locomotives in England are not housed and serv-

iced in a circular roundhouse such as we see in this country; long sheds are used in which they are housed in single file. When it is desired to remove a locomotive from the middle of the shed, it is necessary to move those in front or behind out of the way.

By the use of the English roundhouse method, time consumed in the balancing operation has been reduced from eight to three and one-half minutes. And a noticeable decrease in the fatigue of the test operators has been reported.

The booth is divided into two compartments, one for balancing and one for testing. There are 30 balancing positions in the one compartment, and 21 checking and testing in the other. This ratio between the number of balancers and checkers has been worked out and established by factory experience.

The booth is constructed of insulating material and galvanized sheet iron to produce both acoustic and electrical shielding. The oscillators used to produce the test signals are also thoroughly shielded, as well as the leads which carry the signal to the radio set. There is no interference between the test positions, each operator hearing the signal from her own oscillator only. The booth has forced ventilation, and is quiet and comfortable.

Receivers are fed on the belt conveyors at such a rate that each operator always has a set to test. This rate has been carefully figured out so that there is no lost time. If any position gets out of order, the table is removed and a spare testing table put in its place.

"POWER TOOLS NEVER GET TIRED"

"WHEN we shifted over from hand-power screw-drivers and wrenches for setting up nuts and bolts and screws, we did it because we wanted the extra speed in production," declares a production executive at the Hudson Motor Car Company. "But we have found some other advantages which outweigh the added speed.

"The principal advantage of the electric or air tool, we now see, is that it doesn't get tired. Let me explain.

"See that fellow over there, who lies on his back and sets up four bolts as the car passes over him on the track. It used to be that along toward quitting time his arms got tired. So he didn't drive the bolts home as far as he had driven them when he started fresh on the job in the morning.

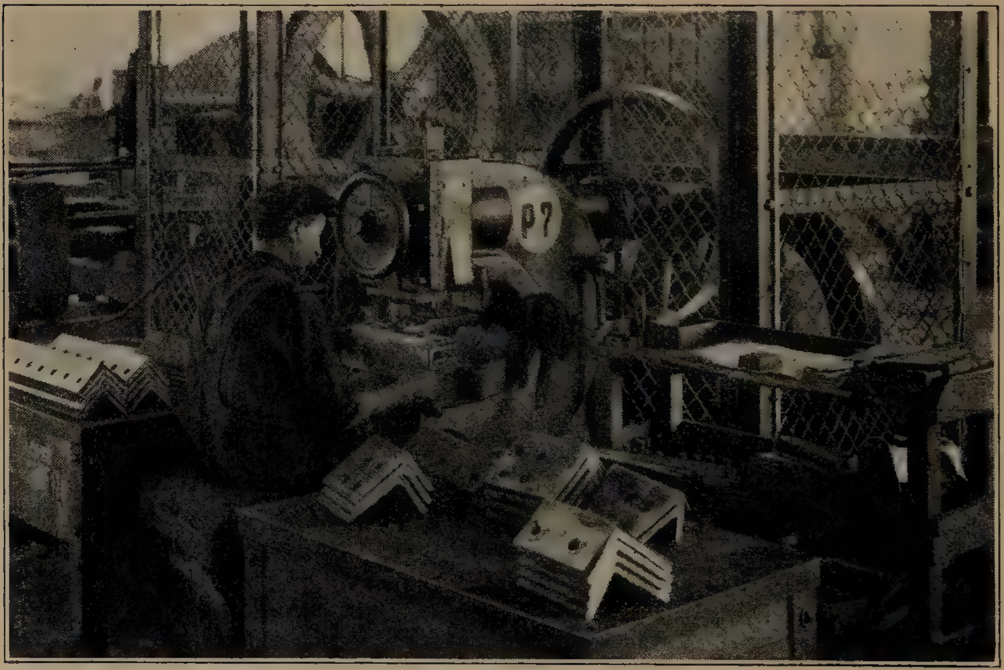
"Quite a lot of minor service work arose after the car was in the user's hands, because those bolts would come loose. Some cars

seemed immune to the trouble, and on others it seemed as if hardly any of the bolts and screws were driven in as they should be. The answer, of course, was that these cars came through those operations toward the end of the day. The men who set up the screws and bolts were tired, and their muscles failed to get that extra 1/16-inch of drive which made the difference between possible trouble and no trouble subsequently.

"Once we began using power wrenches and screw-drivers, all of these troubles vanished. The tool does not get tired. The friction clutch stops the tool at a given point, and no sooner. That is why we say that the greatest advantage of the power tool is that it does not get tired. That is the major reason why we use them all the way through our plants."

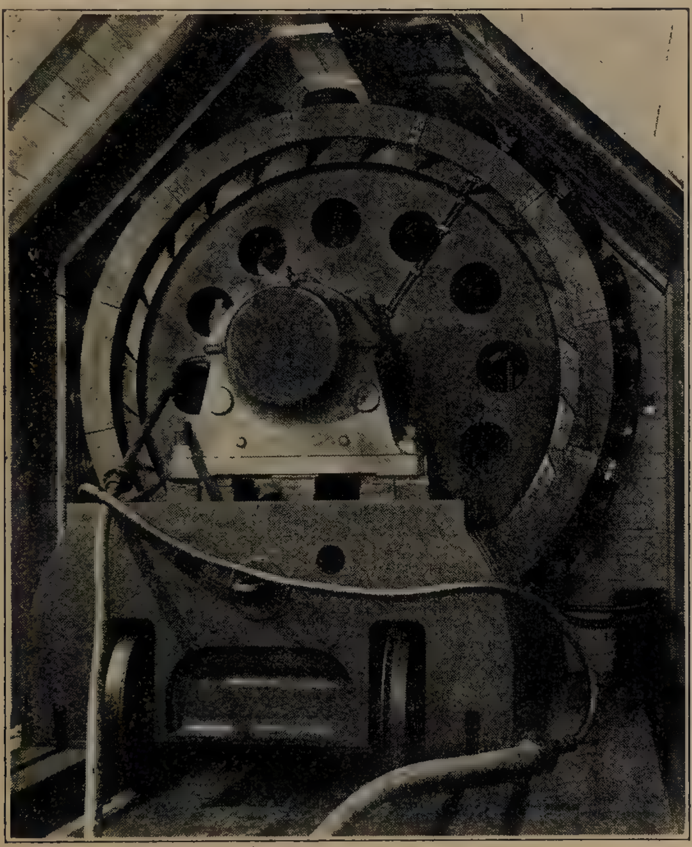
CARDBOARD TEMPLATES FOR SMALL LOTS

LAYING out structural-steel work for punching or drilling is always costly in time, and many expedients have been used to simplify this work. One of the largest companies has constructed a huge automatic machine which mechanically spaces the plate or angle forward and sideways the required number of inches.



Cardboard templates save time and labor over the usual scratch method of laying out lots too small to justify the expense of metal templates or special dies.

Where the punching of small lots of material is incidental to other manufacturing operations, the simple plan illustrated is used by the Union Iron Works of California at Los Angeles, and saves time and labor. Cardboard templates are cut and scored so that they may be folded to fit the piece, in this instance an angle. One layout thus suffices for a number of pieces, a lot otherwise too small to justify the expense of preparing a metal template or special die. Practically all work is handled in this way by the company, only an occasional piece being laid out by the usual scratch method.



High-powered machinery is tested in this company's bomb-proof test-house.

A "PADDED CELL" FOR TESTS

BECAUSE tests under ordinary conditions were so filled with dangers, the Metropolitan-Vickers Electrical Company decided to build a test chamber in which their men could watch the performance of new machines without fear that imperfections might result in injury to themselves. Now "padded cells" are used to test out the machinery.

The walls of the room are 9 feet 6 inches thick, and they are composed of wood, steel, bags of sand, air-cushion space, and reinforced concrete. The chamber is large enough to take rotors 14 feet 6 inches in diameter, or shafts 40 feet long. High-speed motors turn the machinery while it is under test. Such thick walls do not show any undue caution, for a typical 3,000 r.p.m. steam-driven turbo-electric generator with 20,000 kilowatts capacity (26,800 horsepower), having a rotating part weighing 20 tons, would, under overspeed test conditions, possess a stored energy of over 47,000 foot-tons. This energy would hurl the 20-ton rotor to a height of 2,390 feet. The same amount of energy would be developed by a 95-ton cast-iron ball dropped from a height of 500 feet, or by the head-on crash of two 14-coach trains each traveling at 35 miles an hour.

Mechanical failures have been almost unknown during the overspeed tests. But while the men checked up on the machinery by watching it from close quarters, there was always danger. Now, the men watch from outside the padded cell, through a hole bored through the walls. A special telescope permits them to scrutinize the moving parts. In addition, fast cameras take pictures continually throughout the tests, and after negatives have been developed, they are checked over carefully. Several electrical devices are also used to check results. The padded cell has been in use now for several months, and the company reports that the tests conducted in it have been entirely satisfactory and that the safety it affords has built up considerable good-will among its personnel.

WHERE BLUNT NAILS SAVE

AN INTERESTING instance of how it pays management to maintain close touch with the best sources of technical information came up in the experience of a manufacturer whose line includes mops. At the suggestion of the United States Forest Products Laboratory at Madison, Wisconsin, he substituted blunt-pointed for sharp-pointed nails to cope with a problem of too many split handles occurring when wire nails were driven near the ends to attach the metal parts.

In a test run of 1,200 handles only two were split. The reason for the paradoxical reduction in splitting is that the blunt-pointed nail cuts and breaks through the wood fibers, instead of merely wedging them apart as does the sharp-pointed nail.

A mercury vapor lamp tube in the hood throws a cool, powerful, glareless light on the work and makes quality inspection possible.

A BENCH THAT AIDS QUALITY INSPECTION

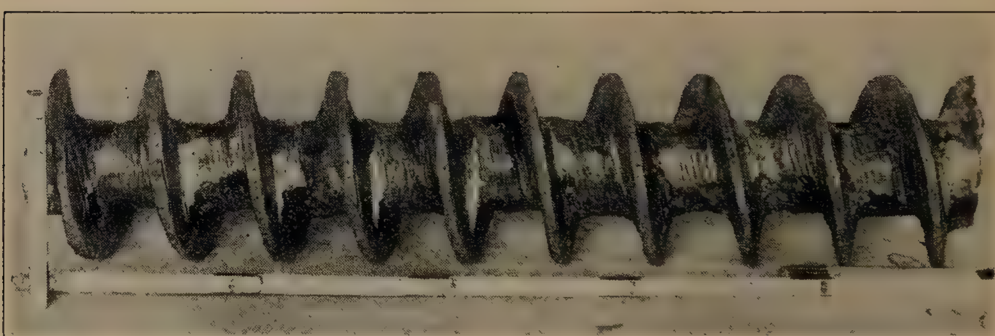
A SPECIAL inspection table has been developed which makes use of the high intensity and visual value of mercury vapor light which is possible with a minimum of heat and glare. It consists in practice of a regular factory bench with a hood mounted above. This hood contains a mercury vapor lamp tube which throws a cool, powerful, glareless light on the work and yet shields the inspector's eyes. The high visual value of this special form of lighting, together with the lack of heat and glare, make the set-up very desirable for

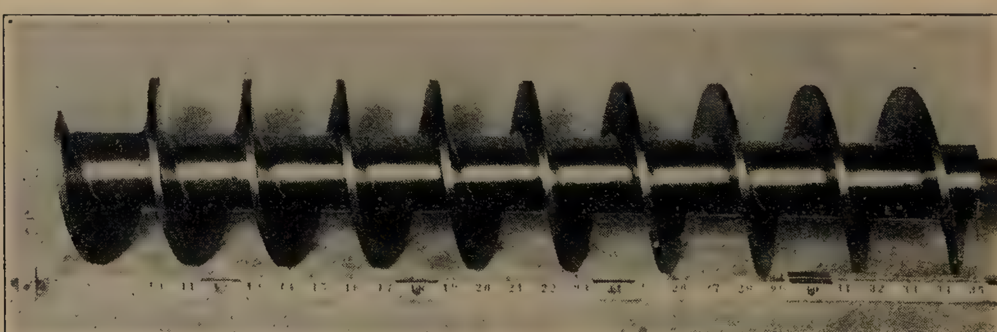
quality inspection, which is one of the most important phases of the manufacturing schedule.

The bench shown in the illustration has been "dressed up" for show purposes and displays samples of the minute defects which can be detected with this special lighting arrangement, and which under ordinary inspection methods might pass unnoticed. Many manufacturers are using it in their inspection departments in preference to daylight because of the value and uniformity of its light throughout the three shifts of the day.

CUTTING A WORM FROM STEEL WITH A BLOWPIPE

HOW time and labor can be saved by cutting a six-inch screw conveyor from solid steel with a blowpipe has been demonstrated at a chemical plant which uses such a conveyor to move small lumps of material slowly through a pipe against considerable back-pressure. As originally constructed, the conveyor consisted of a worm of cast-iron sections mounted upon a driving-shaft, and, because of the frequency with which the sections broke, it had proved unsatisfactory.





Much time and labor were saved by cutting this worm from solid steel with a blowpipe. The photographs were made before and after machining.

A change to cast-steel flights was ordered. But while waiting for the parts to be cast and finished separately, the possibility of using the blowpipe to make the conveyor from one piece of steel was suggested.

Two worms were needed, one 30 inches and the other 48 inches long. Upon each corresponding length of machine steel a single helix of the desired 3-inch pitch was pricked. A templet of sheet metal was then used in making the cuts. Briefly, the procedure was to slice downward to the desired finish of the front side of the blade, across just outside the hub circumference, and upward near the rear face of the next turn. In 5 hours the operator had cut the 30-inch length and in 8 hours more he had cut out the 48-inch piece.

Relatively little machining was needed, but it required much more time than the rough cutting with the blowpipe. The entire labor was two cutters' hours and eight machinists' hours for each foot of finished screw. To this was added several hours of drilling, boring, and keying the ends of the worms for fixing to the driving-shafts. Obviously, a conveyor in which the blades of the worm are integral with the hub is stronger than one composed of flights made separately and mounted on a shaft.

It was estimated that many days would have been required to rough out the grooving in the lathe. And this is corroborated by the proportional time needed to finish the cuts after the blowpipe had cut away most of the excess metal.

IX

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IX

BUILDING UP AND TRAINING THE FORCE

TEST YOUR MAN'S INTERESTS BEFORE HIRING

REAL interests should be distinguished from romantic glamour. There are many occupations, such as explorer or novelist, which attract through sheer glamour, but in which one would not be interested otherwise. It is an advantage if one is interested in the details of the work of some enticing pursuit such as exploring, but having one's picture in the Sunday supplements should not be confused with interest in the details of life which have made possible the accomplishment.

There are several methods which have been successfully used to test the interests of the applicant. A useful common-sense inventory of the applicant's interests can usually be made during the personal

If the interview is handled skilfully, a useful, common-sense inventory can be made of the applicant's interests.

inventory. The interests should be noted by detail rather than by occupation. For instance, the occupation of machinist may involve fine attention to small details, or coarse work. The important factor is not the occupation of machinist but liking fine or coarse work.

A useful check list to use during the interview is shown in the illustration. It can be expanded for the special requirements of in-

INTEREST INVENTORY

Name of applicant ____________________ Date __________

Interviewer ____________________

Check one column at each end of the line.

Liked	Disliked		Months' experience
		Working in a group, with no cooperation needed	
		Working in a cooperative group	
		Solitary work	
		Work with small machinery, with fine adjustments	
		Work with large machinery, without fine adjustments	
		Work with people rather than machinery	
		Work with books and figures	
		Heavy manual work	
		Light manual work	
		Indoor work	
		Outdoor work	
		Work requiring great accuracy	
		Work requiring handling others	
		Fast, repetitive work	
		Work involving sales contacts	
		Work requiring close eye inspections	
		Hazardous work	
		Work which varies from day to day	
		Work with the opposite sex	
		Work with other nationalities	
		Work with people of different religion	
		Work in a smelly place	
		Work in a noisy place	

"Do you like fine work?" This check list can be expanded to meet the requirements of individual companies.

dividual companies. An "Interest Specifications" can likewise be made for each occupation within the plant.

A few applicants during the interview will maintain that they like every kind of work and working condition. If the interview is handled skilfully in a conversational manner this pitfall can usually be avoided. The purpose of the column headed "months' experience" is to give a check upon the likes of the applicants who state that all the features outlined are liked.

There are a few individuals, who border on the abnormal, who can

be interested in nothing, who like nothing. There are a few others who are fascinated with anything they happen to be doing.

It is unreliable merely to ask an applicant how he liked his work as assembler. The morale of the entire plant may have been low, and he will in fairness say he did not like the work. But when the important details of the work are inventoried for his interest in them, the picture is changed.

Interests in total occupations may change from time to time, especially with those under thirty, but detailed interests do not change so markedly. The reason for these changes is open to conjecture. It would not be surprising if they were due in part to failures to build plant morale.

It has also been experimentally shown that in general the employee does the best work while engaged in doing what he likes. But the correspondence between liking to do a thing and ability to do it is not always found. Aside from the question of interest indicating ability, the most important fact is that morale is higher if the worker likes his work. And this question of morale should be one of the primary considerations in placement.

—Donald A. Laird in *Factory,* December, 1927.

HOW FOREMANSHIP TRAINING PULLS DOWN UNIT COSTS

CALLING the foreman "The Key Man in Industry" is a plain misnomer. At least, it has been a misnomer up to the present time, generally speaking, because industrial managers have failed to consider properly the meaning of that phrase. For the average progressive manufacturing business, through mass production and intensive sales methods, has been able to earn a thoroughly satisfactory profit in spite of its incompetent foreman.

Competitive conditions in almost every industry have confronted management today with the question: "How can we make a better product at a still lower cost, so that we may continue in business at a profit?" And in almost every plant, costs of material have been reduced to a minimum. The opportunity to accomplish something worth while is to reduce the processing costs.

This, then, is the current situation. During the past year, the men in charge of production in a good many companies have turned—often with not too much hope—to foremanship training as a possibility for cutting costs. Many of these managers have found, to

their surprise, that adequate foremanship training actually reduces manufacturing costs.

So we see at the close of 1928 a certain prospect that 1929 will bring major studies in foremanship training as a means to, not as an adjunct of, cost-cutting. A handful of companies—Delco-Light and Oakland Motor among the leaders—have attained substantial, definite, dollars-and-cents profits from training their foremen. Next year will see many more in this class.

Training pays because it enables a foreman to qualify himself to bear responsibilities which, properly borne, let him operate his department at a profit. The foreman in a plant which has real competition to meet—this foreman is a key man because he can open or bar the way to manufacturing profits. General managers, works managers, plant superintendents, are realizing that the foreman is worth an amount of serious attention.

Directly in the hands of the average foreman is a machinery investment equivalent to his lifetime earnings. Material and supplies far in excess of the equipment's value flow through his department in a year. If the foreman succeeds in giving the machinery just a little better care or in saving just a little spoilage or in increasing the quality of the work his men turn out, he makes a substantial contribution to corporate profits.

Not long ago an industrial engineer of national prominence analyzed the troubles of the many industrial companies which had called him in to help them over difficult times. He was forced to conclude that the common denominator of the "lame duck" in industries in his experience was poor foremanship. And he declares that if the foremen in these industries had been adequately trained and qualified to assume their real responsibilities, the industrial difficulties would have been materially reduced and sound profits substituted for losses.

He found that most foremen had been selected because of their superior knowledge of the mechanics of the job; because they knew tools; they knew machinery and the product. He also found that they had virtually been told that production was to be their watchword regardless of the costs or the effect on their own or other departments. He found that the cost of scrap, the cost of supplies, and the cost of direct and indirect labor had not seriously entered their minds. Thinking along such lines was, they firmly believed, a

job for those higher up in the organization. Their problem, as they saw it, was production regardless of cost.

Because of their own outstanding workmanship, these men had been selected as foremen. But their new jobs placed them in the entirely new position where instead of being producers they must be leaders. Lacking the training for these new responsibilities, these men had failed in foremanship. Many of their corporate employers failed because the foremen failed.

A succession of happenings like these, pointedly emphasized by the current competitive condition, forces manufacturing managers to realize that their foreman must know not only the mechanics of their jobs, but also must know something of accounting, must know how to teach and supervise the men under their control.

Formerly the foreman knew materials. Now he must know more about money and men. And so we begin to see the management and the foremen working hand in hand, each trying to assist the other in making a profit.

In the ordinary business, however, one may legitimately inquire: "How is a factory department manager, the foreman, going to know when he is making a profit?" In the average plant no mechanism exists for letting him know. Such machinery may easily be provided by establishing standards or objectives for him to work to. Careful figuring and good judgment in the management, coupled with a study of past performance, can set figures for the quantity of scrap that a given production warrants, the volume of supplies, the cost of direct and indirect labor.

If the foreman meets these standards or objectives or cuts under them, he has made a profit for that particular period. When an inherently valuable foreman is given such information and once realizes that the job is up to him, his interest is tremendously increased. He begins to figure means of cutting costs by reducing his scrap and supplies and by operating with the least possible number of direct and indirect employees.

In a plant where foremanship training is getting a real chance today, an instructor recently asked several hundred foremen: "What is human scrap and what is material scrap? When is the human element at fault and when is the material at fault?" After considerable discussion those foremen decided that between 95% and 97% of all scrap is due to failure on the human side and not on

the material side. If foremen properly instruct the men under their supervision and are careful to see that their instructions are carried out, thousands of dollars' worth of material and labor on the material may be saved monthly in any sizable manufacturing business.

C. F. Kettering, vice-president of General Motors Corporation, presents three basic ideas governing foreman training:

1. Instructions tend to degenerate. They get weak and die out, instead of getting strong and developing.

2. We are poor instructors because we are poor actors. More than 95% of all workmen want to do good work if the foreman shows them how in an interesting manner.

3. The foreman is a poor teacher because he is apt to teach the last things he learned and not the first. And the new hand is learning the job from the wrong end.

Adequate foremanship training enables a foreman "to make a better product at a lower cost." The training of foremen at Delco-Light Company and elsewhere has proved that these results can be attained. During 1928 we shall see this truth demonstrated in many factories, with progress based on the lessons that 1927 has taught the pioneers in the field.

—H. L. Neilson in *Factory and Industrial Management,* January, 1928.

ANOTHER WAY OF "DRIVING HOME" SAFETY

FAMILIARITY with safety literature, slogans, and posters often causes workers to ignore them, but The DeLaval Separator Company of Poughkeepsie, New York, has devised a scheme which reaches every worker every day. Short, snappy safety slogans, such as "Be Careful and Fool the Doctor," or "Let's Make 1928 a Safety Year," are printed in bold-face type on every job ticket, so that old workers are confronted with a safety reminder every time they pick up their job tickets, and new workers are at once impressed with the realization that safety talks are made in earnest.

These slogans would, of course, lose their effectiveness were they permitted to become stale in the workers' minds, so slogans are changed about every two months. The use of the job-ticket slogans assures management that every worker will read the slogan, at the very least, one time, and that his attention will be attracted to the safety reminder almost unconsciously many times during the two months.

Ever-present reminders of safety play no small part in keeping punch-press operators from taking unnecessary chances.

FEW ACCIDENTS AT HAWTHORNE

A SAFETY and accident prevention program at Western Electric Company's Hawthorne Works, Chicago, where more than 25,000 men and women are employed, has been largely responsible for reducing the number of accidents to a low figure.

Accident prevention work is carried on at the plant on the basic theory that the supervisor is directly responsible for the safety of all subordinates, and that most accidents are the result of carelessness and can be successfully prevented through the education of the worker.

A concerted effort is constantly being made to drive home to the supervisor and to the worker the idea that no craftsman has mastered his trade until he has learned to perform his tasks without injury to himself or to his fellow employee.

Various agencies are employed to sustain interest in safety work on the part of both employees and supervisors. Every bulletin-

board throughout the plant is supplied with attractive posters dealing with accident subjects, alternating every two weeks with others containing health hints. The photograph shows a portion of the punch-press department where signs on the machines are constant reminders of the danger of taking unnecessary risks. Suggestions for the correction of accident hazards are freely invited, investigated, and the results reported back to the person originating them.

Extensive use is also made of the columns of the plant paper for the presentation of stories concerning typical accidents, brief articles written by supervisors and members of the medical staff, and cartoons pointing lessons in safety. The competitive instinct is cultivated by the supervisors within their respective departments by displaying accident performance statistics in unique and ingenious ways. The results prove that this important phase of management activity can be carried on successfully.

RETAINER COMPENSATION GIVES US A FLEXIBLE WORKING FORCE

THE workman who conducts his own one-man business performs whatever tasks the exigencies of his business require. He is not concerned with holding his activities within the formal outlines of a classification of some one job.

Suppose he is in the business of manufacturing trousers. His primary job is then what the needle trades call pants-making. But when the floor of his shop needs sweeping, our pants-maker sweeps it with never a second thought about this being outside his main job. And when cold weather sets in, he of course takes care of the stove. Carrying coal, shaking the fire and shoveling ashes are not specifically pants-making. But they give him a comfortable room to work in, and he knows that a comfortable workroom enables him to make more pants or better pants, or both.

Likewise with working-hours. Probably our independent pants-maker has set himself what he considers a standard working-day; let's say it is eight hours. But when, on Tuesday, he has an extra pair of trousers to manufacture for delivery early Wednesday morning, he works late Tuesday evening with never a thought about the inconveniences and hardships of overtime. If work is a little slack on Thursday, but with enough work assured for Friday and the days immediately following, he probably goes fishing.

There is about his job a perfect flexibility of operations and hours. He does the necessary work in the necessary hours.

The average girl in the plant knows her own job, the job immediately preceding it, and the job immediately following it.

This flexibility is one of the valuable characteristics which has dwindled to the vanishing point with the development of modern manufacturing. Our business is the manufacture of trousers, just as it was the business of the hypothetical pants-maker. But where the man in business for himself cheerfully performs any necessary job, we used to have considerable difficulty in getting our employees to do work which they felt was outside the line of duty. The tendency was all in the direction of standing around idle rather than performing a task outside the regular duties.

With the day-worker paid by the hour, this is, of course, not acute in a plant where the management tolerates no uncertainty as to who has authority. The piece-worker is a different problem, however. The average piece-worker in any business is a pretty independent citizen. He sees little reason why he should come to work if he feels like doing something else on a given day, no matter how busy the plant is. He does not care much for overtime work, if his piece-rate is high enough to give him a good living. And he feels considerably resentful if enough work is not available to employ him through the standard working-hours. Moreover, he is not inclined to leave his own skilled job to move over into the next department where almost

all the employees have stayed home with "flu" or where for some other reason the production schedule is being slowed down. It is not his worry, he figures.

Some years ago we took one department, in our then new building, and tried an experiment. It was a piece-work department, with every worker on piece-rates, and the usual attitude of complete independence. It was at a time when independence was at the crest of the wave all through industry, anyhow.

I went there and talked to them.

"Any one who wishes to join in this experiment will be welcome," I told these people of the single department. "We are going to pay piece-rates just the same as before. But in addition we are going to pay 18 cents an hour. For this extra pay you agree to do just exactly what you are asked to, and to do it cheerfully..

"It is not likely that we'll want you all to scrub floors. But if you are asked to scrub or clean—or even do painting—you remember you are agreeing to do it when you accept this extra hourly pay. Nobody has to come in under this plan unless he wants to, remember. It's entirely up to you. Now who's game to try it with us?"

Of course some were. It was obvious they would be, with an extra wage for doing as they were told. And when they had agreed to come along, we began trying out various ideas which never in the world could have been tried out with a group of piece-workers on any other basis. Incidentally, we named the extra pay a "retainer," which term has remained in our plant lexicon ever since. A retainer with us means an extra rate beyond a regular piece-rate or hourly rate, in consideration of some special duty or ability which the recipient has attained.

The retainer in this first experimental department completely upset the typical piece-worker's independent attitude. And as soon as we discovered that we had attained this much-to-be-desired end, we began to build the department in a single direction. As a starter, we undertook to make these workers interchangeable. We took people off one operation in the department and put them on other operations until they knew both. We shifted them around and made them useful in every respect that offered. When some operator was absent from a key position, it no longer delayed production in this department. We simply transferred over another employee,

who succeeded in performing the operation acceptably and in acceptable quantity, if not up to what experience had shown was a possibility for a thoroughly trained worker on piece-rates at the job. In fact, we very soon had in this place what was practically an ideal production department. Production was maintained at an even and a satisfactory level. Costs were normal, and the employees were drawing a little extra pay.

As soon as conditions permitted, we shifted the whole plant over to a retainer basis which was derived from what we had learned in this one department. But before going into that, let us examine the "P. A." retainer system which we use to advantage.

A "P. A." is a production assistant—our plant term for a member of the flying wedge or emergency squadron, or whatever you choose to call that group of people who are competent in a large number of operations and are shifted about to meet the needs. Our standard P. A. retainer is 18 cents an hour. A P. A. gets 18 cents an hour even if she sits on a bench in the employment department. But when she goes out to work in a department, she gets her 18 cents an hour *plus* the standard piece-rate for the operation she goes there to perform. She earns, ordinarily, considerably better than the regular operator earns on the same operation, because the skill which en-

I told these people, "We are going to pay piece-rates just the same as before. But in addition we are going to pay 18 cents an hour."

titles her to a place on the P. A. squad is not 18 cents an hour below the average skill of the steady operator whom the P. A. temporarily replaces at the machine.

Of course this means that it costs the producing department 18 cents an hour extra for all production turned out in the department by P. A. help, plus whatever hourly overhead differential there is, due to the somewhat decreased output. The P. A.'s work out of the employment department and are paid on the employment department pay-roll. The production department using P.A. assistance has the P. A. pay charged against the burden of the department and credited to the employment department.

The shift of the whole plant to a retainer basis is concerned also with our "H. O." retainer, which stands for "help out." We did not make the shift all at once, of course.

The plan is grounded on the principle that every one in the plant must know more jobs than his own. Our minimum requirement is that an operator after a reasonable time must know at least three jobs. For the average girls in the plant, this means that an operator knows her own job, the job immediately preceding it or next to it in the department, and the job immediately following it or next to it, on the other side in the same department. This is because the average operator, coming in direct contact with these adjacent jobs, expresses a preference for learning them as her H. O.

Teaching her the jobs is in the hands of the training department. How she is taught her own job, the operation at which she ordinarily works, will be described a little farther along. After she has attained an acceptable proficiency at her own operation, she is permitted to express her preference for the auxiliary operations to learn. If she has no great preference, the training department endeavors to have her learn jobs at which we have difficulty in maintaining production.

The standard H. O. retainer in our plant is 10 cents an hour. This means that the employee who knows another operation is paid, when helping out on this operation, the regular piece-rate plus 10 cents an hour. This retainer is just a little more than half the retainer which the P. A. people receive when working on production jobs.

Consequently the department foreman who has a gap to fill when the plant opens in the morning makes his first effort to fill it from among the regular employees, not members of the flying squadron. Ordinarily he has some one right in his department who will gladly

transfer to the unmanned machine, and operate it with ample skill. If he has not such a person, then he quickly finds out where such emergency operators are, and through their department heads endeavors to obtain them to help out. It is only when he cannot get H. O. assistance—and such a contingency arises only through so heavy a production schedule that no regular operators can be spared from their daily jobs—that he has to turn to the P. A. squad. Ordinarily our production departments are self-sufficient by reason of the reserve of people trained for H. O.

When a new employee is hired who is not already skilled at the operation, she starts through our training school, where she is grounded in the work until she is able to produce acceptable quality. This comes, of course, long before the skill which results in an acceptable quantity of output. Now she is ready to go to work.

Some concerns have worked out on a very scientific basis a scale of what we call training retainers—"T. R.'s" We have never found it necessary to work it out along actuarial lines. Perhaps it is because of the essential similarity of most of our manufacturing operations—they are practically all performed on power sewing machines of one sort or another, after the goods are cut out—that we have been able to arrive at a rough-and-ready way of figuring which seems to fit every need.

The first week that the new operator works for us, and by the first week is meant the first 44 hours of elapsed time, she receives five-sixths of the hourly rate for that operation, plus piece-rates for her production. (We have an hourly rate for each operation performed, as will be explained more fully a few paragraphs farther along.) The first week that the experienced operator is on our payroll, in distinction from the beginner who receives five-sixths of the hourly rate as a T. R., she receives three-sixths of the hourly rate. These are our standards: five-sixths for the beginner; three-sixths for the experienced operator who has newly come to work for us.

The second week the new girl, whether experienced or a beginner, receives one-sixth less of the hourly rate than she reecived the previous week—on the assumption that meanwhile her production will have increased by that amount. And, roughly, this is what our experience has demonstrated. Each week the T. R. is cut one-sixth, so that for the experienced operator it disappears after three weeks of 44 hours each, while for the beginner it strings out over six weeks.

The retainer completely upset the typical piece-worker's independent attitude. We undertook to make these workers interchangeable.

This T. R. is sufficient to keep the new employee on her toes all the while. She has to keep trying for speed all the while, for she knows that when this week is over she will get a cut in retainer. It supplies a real incentive for speed and skill.

Moreover, it is an incentive for the operator to do what she is asked to do, and to do it when we want it done. She knows that in most plants she would get none of this extra pay while learning the job. And consequently she is more amenable to good training and good teaching than she otherwise would be.

Our piece-rates are based on an hourly schedule—that is, we set an hourly rate on a given operation as, say, 50 cents—and 25 pieces as a standard hourly production. The operator at the end of the week is paid for the actual production on straight piece-work which would be, for the example quoted, \$2 per 100 pieces (.50/25=2.00). We do not use bonus or premiums but we do determine rates by means of accurate scientific time study.

We set our working schedules in much the same terms. To be sure, our people come to work at 7:30 o'clock in the morning—but they do not come to stay until 5:00 o'clock in the afternoon. Instead, an operator or group of operators is assigned a given quota

of standard pieces of her operation for the day's work, depending on to what degree we are busy. When she has this job finished, she goes home. And in ordinary seasons, our people are leaving at the end of their work—which means at various hours all through the afternoon.

During the extremely busy seasons, we work a 44½-hour week. In these times our people turn out just as much work as they can during the 44½ hours. But the rest of the year they work according to production schedules instead of working a definite number of hours. And this has some real advantages for them and for us.

We can put our production up or down with no difficulty—this is the chief advantage to us. If work is slack, we make no pretense of working full hours, or of stringing the work out through the week in short-hour days. We simply set so many pairs of trousers as the day's work, and when it is finished the people go home. They take it just the same as did our hypothetical one-man factory, spoken of at the beginning of this article.

Likewise, when work is slack—and, unfortunately, in the garment business it is almost inevitably slack on occasions—we simply announce that no production is scheduled for Saturday. We work a five-day week of comparatively short hours during the slack seasons, but no one among the employees thinks anything about it. It is just a matter of how many hours' production schedule there is, and when there is no schedule there is no work.

So, between our retainer methods and our practice of setting work schedules instead of the hourly basis for the working-day, we have succeeded in regaining most of the flexibility which the one-man manufacturing business, owned by the single workman had. There can be no bottle-neck because of an unbalanced department; we have an ample supply of trained people to handle every job, and because of the mobile reserve of people trained in several operations we keep the whole plant constantly in balance.

To be sure, it costs us something when we have to call on the reserves to bring about the balanced condition of production. But at that it costs a great deal less than does an unbalanced condition.

We are entirely in favor of the flexibility we have attained. There is, after all, no use in having goods to work on and machinery to work on them with, if there is no one to operate the machines.

—Frank L. Sweetser in *Factory and Industrial Management* for April, 1928.

PIECE-RATES OR BONUS—*WHICH?*

IN CONSIDERING the substitution of piece-rates as a method of payment in the shop instead of the present task and bonus system, much of the criticism which has been directed at piece-rates in the past must be brushed aside. Piece-rates are no longer the haphazard guess of some one familiar with the work. They are, or can be, based on just as careful time studies as a bonus job requires, so that from the standpoint of fairness to all concerned there is little to choose between the two methods. Furthermore, experience has shown that bonus times cannot be indefinitely guaranteed to the operators any more than piece-rates. This is due to the fact that at the time the rate is set there is often no operator in the shop sufficiently skilled in the exact work to allow the determination of what will be a fair rate over a period longer than six months' time.

Added to this, minor improvements in the way of doing the work, small additional facilities for doing it, and gradual improvements in the character of the materials occur—none of which by itself justifies a change in the rate set, but the accumulation of which over a period of time does make the existing rate obsolete and does justify setting a new one. In this respect then, there is also little to choose between piece-rates and task and bonus system.

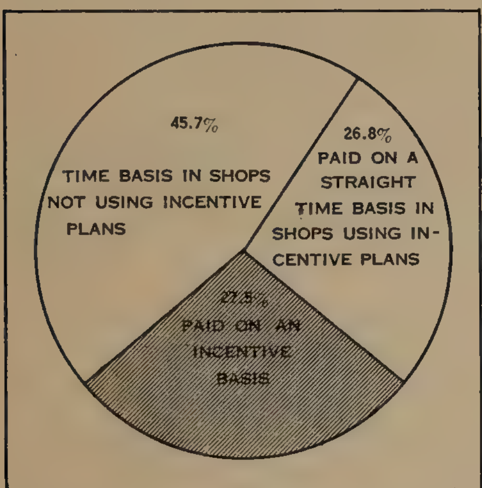
It has been said that with a piece-rate method too much of the responsibility for the conditions under which the work was done was left to the operator, and that many of these conditions were beyond his control, while the method did not interest any one else to help him. With a task and bonus method this responsibility for conditions under which the work is done is placed squarely on the management and not on the operator. This difference in the methods undoubtedly has been true and may still be so in some places, but it is not a difference which necessarily exists. Shop, tool, machine and material conditions can be just as well standardized and kept standard under piece-rates as under task and bonus. And where the management appreciates the value of the plant- or machine-hour, apart from direct labor cost, standards set up through piece-rates are still used.

The chief argument in favor of piece-rate payment is its simplicity, or at least the simplicity which is claimed for it. It certainly is simple to understand and its appeal to the operator seems direct and powerful. A price per piece, multiplied by the number of pieces

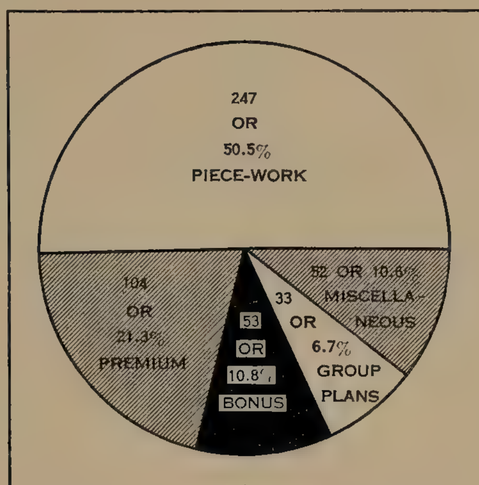
done, gives the contents of the pay envelope by the simplest kind of arithmetic, whereas a bonus based on the performance of a minimum task before anything more than a modest hourly rate is earned is more complex.

And if to the bonus is added a further premium for saving under the task time it becomes still more complex.

But piece-rate is not so simple as it appears. Today nearly all piece-rate methods include a guaranteed hourly minimum rate, and shop conditions often make it necessary to put piece-rate operators on hourly rate jobs temporarily. The contents of the pay envelope then require more computation. Still it would not be fair to say



Wage plan used in 672 plants. Of these shops 365 used incentive plans of various types as shown.



Summary of a survey by the National Metal Trades Association of the use of various wage plans.

that task and bonus was as easy for the operator to understand or to figure as the most complex straight piece-rate.

Piece-rates also seem simpler from a cost and recording standpoint than does task and bonus, but here the difference is much less real. When analyzed in detail the amount of clerical work involved by either method is about the same, but since it is customary to do more of this clerical work in the shop with piece-rate, there is less work done in the office than with the bonus method, so that it seems simpler from the accountant's standpoint. It also seems very simple from a cost or estimating point of view to take a price per piece as a labor cost. The bonus plan, however, gives this just as readily and

has the advantage of giving real figures of distributed burden, whereas, unless separate machine-hour records are kept, all the burden distribution a piece-rate can give is an estimated amount per piece, regardless of the time in which the work was actually done.

None of the foregoing is to be interpreted as belittling the value of piece-rate or what it does accomplish where no other incentive to individual effort is used. What it has done and can do is familiar to every manager. But that it is a better and simpler method of wage incentive than the task and bonus method is certainly open to question. For example, is there anything in the psychology on which piece-rate is based which makes it superior to task and bonus? To be sure the operator is left free to do as much work as he wants and his pay is in direct proportion to what he does. Task and bonus requires a supplementary premium to give the same results in this respect, but several such premium plans have been worked out and proved satisfactory and one is in operation in our plant. There is no more of the operator's self-interest enlisted by one plan than by the other, and experience has shown that the appeal to self-interest created by piece-rate is sometimes less than with task and bonus.

In 1920, owing to the shortage of girl operators in this locality, a section of our work was established in a small town 20 miles distant where girls were still available. These girls were better educated and apparently better equipped in every way than the average girl we were able to get at our main plant. They were accustomed to factory work and to piece-work as the town had a cannery in which all the girls we employed had worked during the canning season. Our branch was started when the cannery had finished its work for the year and would not start up again for eight or nine months, and as there were more girls in the town available than we needed there was much more incentive for these girls to hold their jobs with us than we could expect from the girls at the main plant. The work which was done in this branch plant was identically the same as the work at the main plant, and the same machinery, tools, materials, and shop conditions were provided. The instructors and foremen used were taken from the same work at the main plant and everything was conscientiously kept the same in order to produce the same results. The only change was in the method of pay. Since we were in a hurry to get started, and since these girls were used to piece-rates, we used a piece-rate which was arrived at by dividing the

Wilson and Company, also using a bonus plan, uses separate checks for day-rate and bonus earnings. This directs attention to the possibility of increasing the size of the bonus check.

task bonus earned at the main plant by the number of pieces in the task. The guaranteed hourly rate was set at the customary local figure which was a few cents under the rate at the main plant. But the piece-rate was not based on this as we did not want the same articles coming through our cost at two different labor rates.

This branch plant was operated for 5 months during which we trained about 50 girls. Of them 30 stayed for a period longer than that allowed at the main plant for an operator to gain the skill required to make the task. The guaranteed hourly rate was the equivalent of only two-thirds the number of pieces in the main plant task, figured at the piece-rate set. We were not seeking a comparison of piece-rate and task and bonus, but everything was arranged to make such a comparison the inevitable result of the relative performance of the two groups. We had about 50 girls at the main plant on the same work.

The results were as follows: Only one girl in the branch plant ever made the number of pieces required by the task at the main plant, and she never exceeded the task by more than one or two pieces. At the same time all of the girls at the main plant made

their task with consistency if not uniformity. The average performance for this group was 101% of task. This was because several of these girls consistently beat the task by 12% to 15% or 20 to 25 pieces, lifting the average.

Of the other girls at the branch plant, 18 earned more than the guaranteed minimum. Their performances ranged from just over the minimum to 15% or 25 pieces below the task. The remaining 11 girls never earned in piece-rate as much as their guaranteed hourly rate and their records were not kept after the branch plant was closed. Every decent method was used to urge this group to better production, as we needed the output, and the equipment would have given it to us had the task output been reached as at the main plant. Our efforts had little or no effect, however, and the branch plant was closed without the situation having changed.

This experience is cited here to help answer the next question about piece-rates—what standards of performance do they set? For if pieces-rates give the operator the chance and inducement to make all he can they also leave him free to make as little as will satisfy him or as the established standards will permit. It is also a widespread criticism of piece-rates that the operators working under this method come to a common understanding as to what is a day's work, and that this is seldom exceeded. In either case the standard of performance is determined by the operators and not by the management, though the cost to the management of the equipment used by the operator may be substantially greater a day than the operator's earnings for the same period.

It is practicable of course for the management to set standards of performance based on time study just as a task and bonus method does, but then the performance of each piece-rate worker must be checked against this standard, which further complicates the working of the method and makes its cost equivalent to the bonus plan. There is also a tendency to set such standards lower than they would be set under a bonus plan, because no definite sum of money depends on the standard under piece-rate, and an average rather than a good performance seems satisfactory.

As these adjuncts of the task and bonus method are taken over and incorporated in piece-rate methods, the one shortcoming of the bonus plan, namely, its complexity, becomes less and less obvious and it is hard to see in what other respects the piece-rate method is

Accurate rate setting and study of operations, coupled with a well-devised gang bonus plan, made possible savings totaling over $11,000 a year.

superior to or corrects faults in the bonus method. Neither is it clear that piece-rate is a greater incentive even though it leaves the operator to his own devices. The exceptional operator may be stimulated to exceptional performance, but would not the same be true of task and bonus? If we may trust the printed reports of its performance the bonus method has just as many outstanding performances to its credit as piece-rate or premium has.

Lastly, it is not apparent that piece-work, even in its most modern form, has any miscellaneous advantages either for the operator or management which do not result equally from a task and bonus system. Why then should a plant operating under a task and bonus system with reasonable success consider changing to piece-work?

The most important reason is the greater simplicity of the piece-work system to those of the management, who are not experts in the application of either method.

Moreover, as has previously been shown, if the piece-rate plan embodies time studies, proper performance standards, and management responsibility for working conditions—as the most recent piece-work plans do—the greater simplicity of piece-work is more

apparent than real. For the same reasons a piece-rate plan is no cheaper in clerical work to operate.

That many successful plants use a piece-rate plan is quite true. But has it ever been calculated how many equally successful plants do not?

For those plants which are already using piece-rates it is undoubtedly simpler and better to modify the straight piece-rate along modern lines than to take a chance of serious dissatisfaction by an entire change of the methods of payment.

This seems to be the main reason why piece-rate is still so widely used. It does not apply, however, to a plant which has never had piece-rate and which has made the effort and successfully installed task and bonus.

But are there any inherent defects in a task and bonus plan which a piece-rate plan would not have?

And here again the charge is complexity and excessive cost.

As to the first, it is interesting to note that in the entire 13 years' experience of this plant, averaging 750 employees, there has been no case of an operator complaining that our task and bonus plan* was complex, there is no record of an operator leaving because the pay envelope could not be calculated, and there is no adverse reputation of the plant in the labor market because of its method of payment.

On the other hand, the experience has constantly been that the operators knew to a penny what should be in their pay envelopes and drew attention to any error or shortage that might occur with confidence and promptness.

As to the cost, our treasurer estimates that a piece-rate plan of equal effectiveness with the task and bonus plan as to times, standards, and incentives, would cost just as much to operate.

Such adverse criticisms as we have had seem to come not from those who are working under and with and benefiting by the plan, but from those who view it academically or without real knowledge of it, or because some one else, who is to be admired, is using piece-rates.

The operators would gain nothing by a change as now they are at liberty to earn as much as they can.

* Job time standards are set and the operator's pay is computed as the number of pieces produced, multiplied by the allowed time per piece.

Rather would they stand to lose a large part of the help and cooperation which they now get from their supervisors if the bonus plan in which those supervisors share gave place to a piece-rate plan in which the supervisors had no part or interest.

This linking together by a common interest in the result of operator and supervisor is a feature of decided superiority in the task and bonus plan which no piece-rate plan now in existence includes.

The management would gain nothing in cost or ease of operation by changing to piece-rate, and it would saddle itself with all the disagreeable bickerings which fixed money rates per piece are likely to cause when an operator is shifted from a higher class of work to a lower where the earnings for standard performance are less.

Yet such changes are necessary in every plant and particularly so in ours. This rigidity of value of work done is a real disadvantage to piece-rates which no device yet found overcomes satisfactorily. It seriously limits the movement of operators which a foreman can make with fairness.

When moves of this sort have to be made it creates dissatisfaction all out of proportion to that which a change of job almost always involves. And it appears to an outsider, certainly, as a sacrifice of the individual to the method, which is a fundamental defect in the method itself. No similar defect can be found in the task and bonus method.

Is it not clear, therefore, from the above summary of the features of both plans, that the cost and trouble of making a change would not be justified unless a material saving in the cost of operating a modern piece-rate plan can confidently be prophesied from the cost and pay-roll changes it will bring about? Or unless it can be shown that a material increase in good-will on the part of the operators towards the management, or a definite increase in output per day will follow? As there is no valid ground for expecting either of these results it is recommended that no change be made.

INCREASED PRODUCTION WITH THE SAME PAY-ROLL

A BONUS plan, very simple and easy to handle, is in effect at our shop, and gives most satisfactory results.

The bonus plan at our plant is based on the ratio between pay-roll and shipments.

After reviewing the records of several years past, it was found

that a multiplier could easily be found for the pay-roll which would approximately equal the shipments. For instance, if the pay-roll had been $20,000, the shipments would average $80,000, so the multiplier determined would be four.

This multiplier was then increased, and it was decided to pay a bonus on the excess shipments over the par determined by multiplying the pay-roll by the multiplier. For example, we can consider this multiplier as five. Therefore, if the pay-roll were $20,000, the par shipments would be $100,000 and bonus was paid on shipments exceeding $100,000.

If the shipments were $120,000, the bonus would be paid on $20,000. This bonus is a certain percentage of the excess and, for example, let us consider it as 2½%. Therefore, on shipments of $120,000, with a pay-roll of $20,000 the net bonus would be 2½% of $20,000, or $500.

This $500 is divided share and share alike among all foremen, heads of production departments and others who could in any way directly influence the amount of production. In our particular shop it is divided among ten men, so with $500 bonus each one of these men receives $50.

The pay-roll includes productive and non-productive men, foremen, and all men in the shop organization. The foremen have been impressed with the necessity of keeping the pay-roll as low as possible, regardless of whether the men are productive or non-productive, for reduction in the pay-roll means money in their pockets. If a man is hired whose wages would be $100 per month, unless this man directly increases the shipments $500 per month, the foremen and those sharing in the bonus lose money. If the man produces no increase in shipments, it costs those sharing in the bonus $12.50. If the man increases the shipments $1,000, they gain $12.50.

It has been found that the foremen and others sharing in the bonus fully realize this condition and are very careful in the hiring of men, particularly non-productive men, and they are not only careful in their own departments, but when they see what appears to them excess help in other departments, they bring it to the attention of the superintendent or foreman. The plan has also assisted in decreasing unnecessary overtime, for the foremen realize that overtime is actual loss to them, unless production and shipments are materially increased.

The amount of bonus can be easily determined by the accounting department within two or three days after the first of the month, so that the men sharing in the bonus receive their bonus checks before the fifth of the month following. Prompt payment is very desirable in any plan of this character.

The men understand exactly how the bonus is figured and have appointed a committee who have the privilege of checking the bonus with the accounting department at any time they desire, although such check has only been made once since the plan has been in operation, and this at the request of the management.

If it is not desired to have any one know the dollar and cent value of the shipments, this plan can be worked on points. That is, give each particular class of product a certain number of points regardless of its value and have a certain number of points for each thousand dollars of the pay-roll.

If it is not desired to work the plan on shipments, it can be used on the amount of material placed in stock or in the storeroom. This, however, involves considerably more complications and has not been found necessary, as the plan of paying bonus on shipments seems to average up very well in the long run and works out satisfactorily.

Since putting this bonus plan in operation, production of the shops using it has been increased more than 25% without any increase in the pay-roll.

—F. W. Magin in *Factory*, August, 1927.

X

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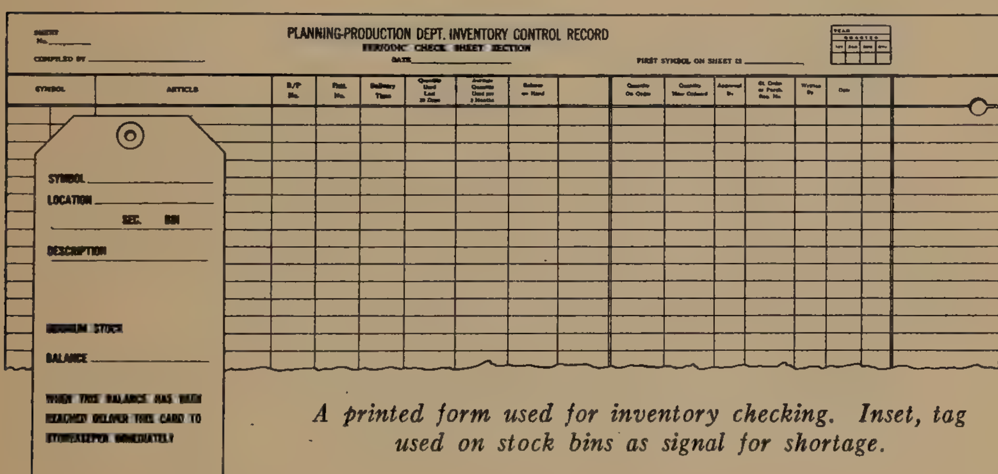
X

MATERIALS, COST AND PRODUCTION CONTROL

A PLANNING DEPARTMENT THAT PRODUCES RESULTS

PLANNING work is one angle of business which each day grows increasingly more important. The narrowing margin between cost and sales price insists that management know definitely what it is doing, what products it will make, and where, when, and how it will make them; deliveries must be speedy because management has been taught to keep cash liquid and avoid excessive inventories.

The major functions of a planning department are, generally, to decide, record, and instruct on: (a) what work is to be done; (b) where work is to be done; (c) when work is to be done; (d) how



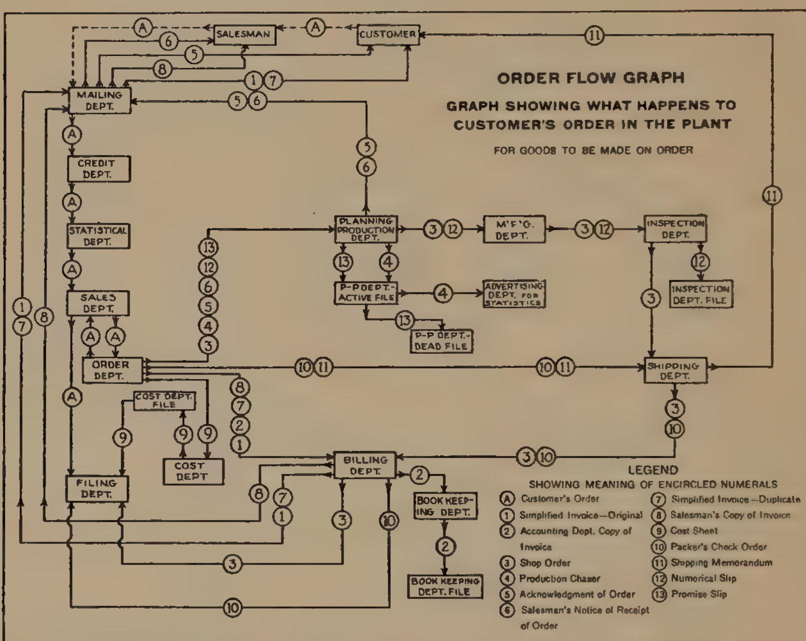
A printed form used for inventory checking. Inset, tag used on stock bins as signal for shortage.

work is to be done. Its usual sections consist of: Routing: prescribing the path which work will follow; Scheduling: planning the amount of work to be done; Dispatching: seeing that orders are issued, materials and tools on hand, job cards issued, and that schedules are carried out properly.

Tracing the procedure in our own planning department, to start with we must know what to make. This is arrived at primarily by merchandising demands, research, development and final release

of finished article by engineering department to planning department. In the various stages of development it is the duty of the planning department to supply the engineering department, upon request, with all the information available and procurable as to tooling, machining, and so on, toward the end that this knowledge be incorporated in the final design.

Regularly, with current items, what to be made is authorized by (1) catalog; (2) shop orders (from sales department to planning department); (3) suborders (from planning department to shop departments); (4) stock orders (from planning department for



This order flow graph shows what happens to a customer's order for goods to be made on order.

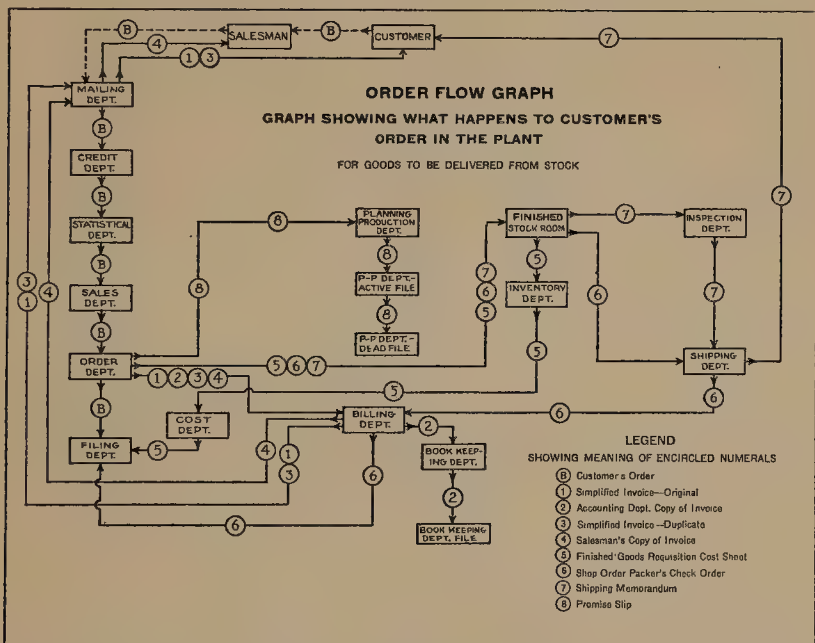
goods to be kept in stock); (5) repair orders (from sales department to planning department); and (6) internal shop orders for experimental, drafting, tool and maintenance work. These are all passed on by the planning department.

In determining where work is to be done: (1) Outside purchases are requisitioned by inventory division, planning department; (2) instructions clerk, planning department, reviews all orders and checks operations and departments in which work is to be done.

To determine when work is to be done: All promise dates are set

by order clerk, planning department, working in close harmony with order of work division. Each order is followed daily, by operations, by follow-up clerk. Visible control (visible index method) of each order is kept in the planning department, under jurisdiction of the order of work division.

How work is to be done is determined as follows: Design is received from engineering department. Planning department insists that all drawings be properly dimensioned and that proper tolerances are shown. Instructions clerk records matters of operations layout, tools, parts lists, materials, and instructions. Orders re-

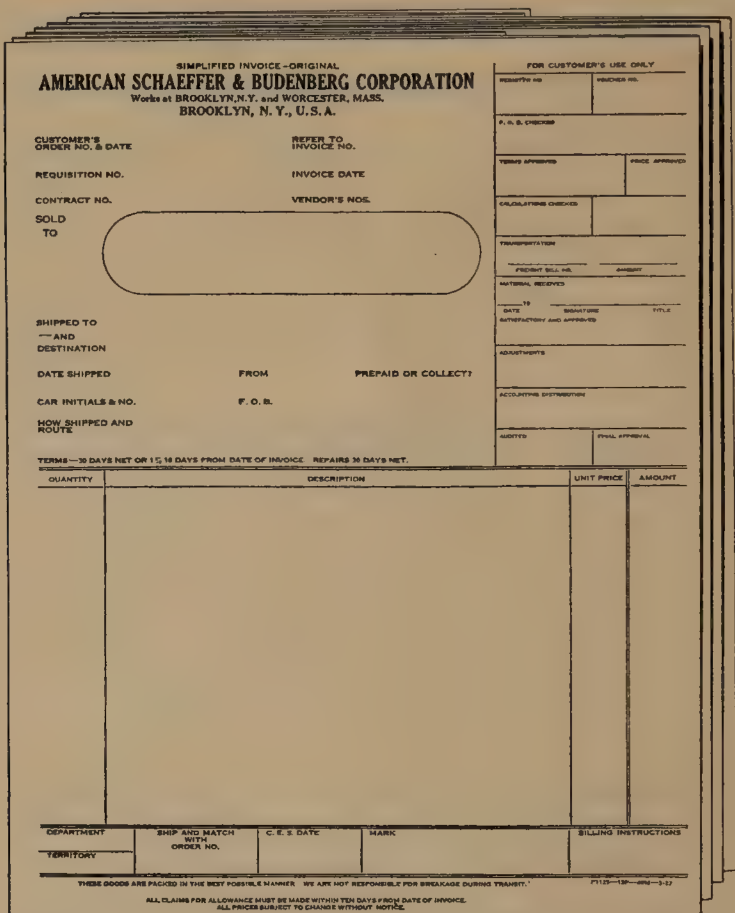


Here in visual form is the routing of a customer's order in the plant when goods are to be delivered from stock.

ceived are censored by instructions clerk and, as needed, special specifications added to order; sketches are also supplied as required. The final arbiter of how work should be done is under engineering department authority. This includes inspection of all raw materials and purchased parts to insure checking with purchase order specifications, and final inspection of finished goods.

This sums up the planning department's activities in deciding, recording, and instructing on what work is to be done and where, when, and how to do it.

To the left of the printed inventory form reproduced with this article is a description of the part with related information, and to the right a check sheet showing present balance of stock, stock movements, what we have done to overcome short balances, and necessary approvals for so doing. With this method we check each part on our inventory at least four times a year and in a large measure "bumpy" stock situations are obviated. In addition to this



SIMPLIFIED INVOICE—ORIGINAL

AMERICAN SCHAEFFER & BUDENBERG CORPORATION

Works at BROOKLYN, N.Y. and WORCESTER, MASS.

BROOKLYN, N. Y., U.S.A.

CUSTOMER'S ORDER NO. & DATE — REFER TO INVOICE NO.

REQUISITION NO. — INVOICE DATE

CONTRACT NO. — VENDOR'S NOS.

SOLD TO

SHIPPED TO —AND DESTINATION

DATE SHIPPED — FROM — PREPAID OR COLLECT?

CAR INITIALS & NO. — F. O. B.

HOW SHIPPED AND ROUTE

TERMS—30 DAYS NET OR 1% 10 DAYS FROM DATE OF INVOICE. REPAIRS 30 DAYS NET.

FOR CUSTOMER'S USE ONLY

F. O. B. CHECKED

TERMS APPROVED — PRICE APPROVED

CALCULATIONS CHECKED

TRANSPORTATION

FREIGHT BILL NO. — AMOUNT

MATERIAL RECEIVED

DATE — SIGNATURE — TITLE

SATISFACTORY AND APPROVED

ADJUSTMENTS

ACCOUNTING DISTRIBUTION

AUDITED — FINAL APPROVAL

QUANTITY	DESCRIPTION	UNIT PRICE	AMOUNT

DEPARTMENT / TERRITORY	SHIP AND MATCH WITH ORDER NO.	C. E. S. DATE	MARK	BILLING INSTRUCTIONS

THESE GOODS ARE PACKED IN THE BEST POSSIBLE MANNER. WE ARE NOT RESPONSIBLE FOR BREAKAGE DURING TRANSIT.

ALL CLAIMS FOR ALLOWANCE MUST BE MADE WITHIN TEN DAYS FROM DATE OF INVOICE.
ALL PRICES SUBJECT TO CHANGE WITHOUT NOTICE.

Original orders are converted to a 13-form order set. Copies are routed to the proper points.

check we hold individual stock-bin signal cards or "flags" from which the stock clerks notify us of stock shortages.

Shown also are the flow of order for goods to be made on order and the flow of order for goods to be delivered from stock. We will follow only the planning department contacts here:

The original order comes from the customer, through the salesman, to our mailing, credit, statistical, and order departments. It is converted to our 13-form order set; the original order being sent to the filing department.

Out of the order department, going to the planning department, we follow copies 3, 4, 5, 6, 12 and 13, shop order, production chaser, acknowledgment of order, salesman's notice of receipt of order, numerical slip and promise slip respectively. In the planning department the order is analyzed by the instructions clerk and where necessary, blue-prints and other data procured from the drafting department, or a special sketch made. The order then proceeds to the order clerk, who analyzes the order and sets the promise date. The promise date is placed upon all copies and the acknowledgment of order and salesman's notice of receipt of order are forwarded to the mailing department from which they are forwarded to the customer and salesman respectively. The shop order and numerical order together with all requisitions and sub-orders go to the manufacturing department through the stock-room. When goods are made, both copies are delivered to the inspection department where the numerical copy is kept, filed according to serial number, and the shop order, after inspection of the goods, sent with the goods to the shipping department. The promise slip and production chaser are kept in the planning department files until the order is delivered for shipment and then the promise slip is transferred to a production department dead file and the production chaser is sent to the advertising department for statistics.

In the manner just related, the customer's order reaches the order department and is converted into an eight-form order set. Of this set the planning department receives but one—Number 8, the promise slip—as a record of the order, and this is held, alphabetically by customer's name, until goods are shipped.

—Joseph M. Schappert in *Factory and Industrial Management,* March, 1928.

PURCHASING FOR A FAST RATE OF TURNOVER

WITH the small profit margins available today, and assuming that costs and expenses have been trimmed to a minimum, there remains but one opportunity for increasing the annual net earnings: more rapid turnover of working capital. I do not feel that we shall see marked price reductions in the coming months;

but instead possibly a demand for a greater refinement of product, which is in effect the same. This means that management attention must be directed, with keener application than in the past, to ways of converting inventory into dollars speedily. To gage the turnover, balance it with sagacious purchasing, means a piling up of small profits constantly recurring through the year. How is this to be done? We believe by adequate control of inventory. And this in turn may in the last analysis be summarized thus: watch demand. In our manufacturing management we use three words: Watch Dealer Demand. There is no better starting point than a careful and continued survey of the buying trend as reflected in the dealer body.

It is not many years since the control of purchasing was a haphazard affair, to which attention was given only at periods of actual physical inventory, annually or semi-annually. Buying in the interim often became a matter of one man's guess.

My observation of the method in use for handling finished stocks by the large agricultural implement companies in earlier days, laid the groundwork for our present policy in purchasing for rapid turnover. I found that these companies carried a minimum of finished stock at factory, but depended instead on the ability of their branch managers with warehouse stocks of implements placed throughout the country, to predict sales and control production.

Purchase control in these companies was, to an extent, decentralized; they were taking into account the forecast of a group of men—guessing possibly; at all events it was not one man's guess, but many.

At that time, however, the control of inventory and its relation to rate of production was considered little. Large stocks were considered an evidence of responsibility. But in my experience with companies whose management had been intrusted to me, and in my observation of other business organizations, it long ago became apparent that methods for control of purchase and inventory were receiving far less attention than their importance demanded. Capital lying idle pays no dividends, and every dollar tied up in excess stocks can be regarded only as lost profits. Yet instances were not uncommon where companies continued to pay interest on money borrowed and converted into raw stock which lay untouched for months in warehouse or storeroom.

Some years ago on assuming the management of an automobile manufacturing company I found this condition of overstock prevailing to an extent that was not only a distinct source of lost profit but also a menace to the very existence of the business. For example, those in charge of the repair-parts stock-rooms in the branches of this company were responsible to no one in the factory organization as the sum total of parts carried. The resultant accumulation of excess parts was appalling.

I took vigorous steps to improve the situation. At the end of the year following, the repair-parts item had been reduced one-third for the entire chain of branch stocks.

Factory inventory has in a good many plants duplicated these old-fashioned conditions. Not so with us. Our factory layouts have been planned to permit the routing of raw stock from unloading dock or yard storage to presses, forge, or machine-shop, the processed material all converging at the beginning of the assembly line. The goods in process at the end of any working-day are only the contents of the department trucks and such material as is left on the conveyor rollers.

Here again is emphasized the multiplication of profits through the speed-up in turnover resulting from a low, yet adequate inventory. From the beginning of the assembly line, the car moves forward rapidly to completion and is then ready for road test and shipment. This is a vital factor in turnover of manufacturing capital. It is in effect both reducing our goods-in-process inventory and, as it speeds up production, spreading overhead through an increased output.

Straight-line production, then, is one step toward adequate control of inventory—more rapid turnover. For the second step, of paramount importance, I must go back to my opening sentence and repeat: Watch Dealer Demand. There is no set formula by which to gage sales and so control production. At best it is only a guess, or, if the word seems objectionable, a rough estimate. However, it is necessary to follow some procedure which will reduce the hazard of over- or under-production to a minimum.

If the naturally optimistic sales department is to be the sole guide, the plant may find its warehouses suddenly bulging with the finished product. The finance and purchasing departments often lean to conservatism. But they are all concerned, or should be, in the budgeting of purchases. In our business, and no doubt it is true of

others, our sales are seasonal to some extent; they may be inconsistent with comparative periods, also. There are automobile manufacturers who have entered a new year with a good product and a history of record-smashing sales behind them in the previous twelvemonth, to find their market narrow suddenly, and sales unaccountably decline to a new level. In this, possibly the automobile industry shares with the millinery business the unique distinction of a business in which style changes constantly, and appearance is a prime consideration. There is danger in the budgeting of automobile production on past performance. How then are we to plan our purchase schedule?

We order for a period limited to 90 days, believing that this is the longest period for which we can safely forecast. We believe it unwise to carry stocks for estimated production over more extended periods. At times we may lose the advantage of a money-saving purchase for a long up-swing, but the law of averages levels these "good buys" with others not so fortunate.

We schedule our purchase budget quarterly in conference of the heads of our purchasing departments, the men responsible for production, the sales managers, and our general officers. The control of inventory is set by our joint decision at these conferences; it summarizes the collective observation and experience of all of us who are concerned that the schedule prove a correct forecast.

No one who sells through so-called "regular channels of distribution" can fail to recognize the dealer as an important factor in turnover. It is the dealer on whom we are dependent for the sale by which is released the capital tied up in our finished stock and with it the unit of gross profit. He furnishes the impetus which, if we take advantage of it, will keep inventory dollars rolling.

Controlling inventory on its mechanical side is not difficult. It calls for common sense. To purchase with consistent judgment, neglecting neither quality nor first cost, requires specialized knowledge; men must be trained, must have acumen to buy rightly. Controlled production, careful buying, are essentials, but they must be founded on alert, intelligent forecasting of demand, to serve their purpose and speed the rate of turnover.

The coming months will place before management new problems for solution. The trend will be toward quality, but with prices remaining at low levels. We must be alert to decrease costs by the

installation of more efficient mechanical appliances; we must be more concerned with the competence of labor than at any previous time in the history of industry. The product placed before the consumer must have incorporated in it the refinements which good judgment and a vigilant survey of the field indicate that he demands.

Then, an adequate control of inventory through wise purchasing will function to a maximum of profit by the resultant speeding up of turnover.

—C. W. Nash in *Factory and Industrial Management,* January, 1928.

COST CONTROL THROUGH BUDGETING

STUNT budgeting is just about as useless on the one hand and as dangerous on the other as is stunt flying. No more in industrial management than in aviation do purely spectacular activities contribute anything to progress.

I speak of this at the outset because under present conditions of narrow margins when really close control of production is so highly desirable, it is particularly unfortunate if a company more or less looks upon production-budget control as a "stunt." Fads have no legitimate place in 1928's managerial program. Conditions will not permit them. But sound budgets have a very real duty in these days of careful cost control.

The aim of production budgeting, as we see it, is to secure lower costs, better operating conditions and increase over-all output per

Closer cooperation between production manager and sales department has helped in increasing the capacity of existing plant.

given plant, and to reduce capital investment by stabilizing as far as practicable the production schedules of the plant. Now if a production-budget control can actually accomplish those ends, is it not an implement to be taken out of the executive tool-kit to be sharpened up right now at this time of striving for fast turnover and low costs?

And the highly desirable feature of a practical budget control is that it serves equally well whether your immediate production is swelling or shrinking. Its aim is not necessarily to increase production. In a period of stagnation the budget may be used to limit production, without a panicky jamming on of the brakes. Rather the budget guides such a restriction in an orderly and predetermined manner in line with known facts.

Before we had the budget, in common with many another successful company, we were prone to overshoot our immediate goal. In periods of restriction as well as of increasing production our momentum would carry us beyond the mark before the controlling outside conditions filtered through to the production department.

Contrary to general belief the soap business is subject to seasonal fluctuations which are often aggravated by buyers' apathy due to general business conditions. At such times dealers' stocks are apt to be large and slow-moving, resulting in severe curtailment of orders and rapidly increasing stocks in our warehouses. Meanwhile the factories would be operating to capacity and when the news finally found its way through to the production departments, on would go the brakes with the inevitable disorganization of all departmental plans. Any one at all familiar with plant operations knows that such violent fluctuations are one of the principal causes of high cost of production.

Such a situation can be greatly relieved through the intelligent use of the production-budget control. We know that it has done so in our case.

But it always seems to me that there is a danger in talking with other executives about the advantages of a budget, whether it be for the control of sales, finance or production—a danger that the hearer will rush off forthwith and try to wear a budget suit tailored for some other man. Detailed methods—notice I say detailed—cannot be transferred from one plant to another. The reason for using one out of many possible methods often is more dependent

upon the personal equation than upon a technical decision. The broader considerations of the budgeting idea and its basic principles on the other hand, are widely applicable.

Important as the production budget is under present conditions for controlling costs, I would feel guilty if I did not warn against overenthusiasm in applying budget methods without a thorough understanding of the work involved.

Nor is this warning based upon any lack of belief in the efficacy of properly installed budgets. But they, like any other powerful tool, can do a vast amount of good or harm according to the way in which they are used. Carefully set but arbitrarily applied budgets can disrupt any perfectly healthy organization. So to suggest this device, even at a time when it is as badly needed as now, carries with it the necessity for frankly stating its limitations as well as its uses and for emphasizing the need for preparatory work which alone will insure its success.

And at the risk of being misunderstood, it is my firm conviction based upon Palmolive experience that production budgets are much more difficult to put into practical operation and require more preparatory work than either sales or financial budgets. Perhaps it would be more correct to say that more subcontrols must be installed as a foundation for production budgets than for either of the other two.

Due to what we think are rather remarkable results secured through a merchandising policy and sales-control plan, the Palmolive sales have been stepping up very rapidly for a number of years. To meet this, the company has been compelled to increase its productive capacity by actual additions to plant, but it has wisely tried to hold plant additions down by securing an ever-increasing capacity from existing plant.

We have been largely helped in this increase of capacity of existing plant by closer cooperation between the budget-creating function (sales) and the budget-producing function (manufacturing). Our production manager works closely with the sales department and on a very friendly basis.

Looking back at some of the methods which we employed, we realize that they were extremely crude. But crude as they were, each new method adopted constituted a satisfactory step toward better control. The crudities in a budget plan always work them-

selves out as all the other elements of the control system become better developed.

This natural step-by-step improvement should be proof enough that my warning a moment ago against abortive attempts at budget control was not a plea for postponing all attempts to control until you could do a 100% job of it. I was simply bringing out the truth that satisfactory control can come only over a period of years and after consistent and sustained effort.

Very briefly the definite steps which we found necessary in attaining budgetary-production control are the following. I mention them because they cover the main points of most such problems before all of us today.

First, warehousing was centralized at fewer and better controlled storerooms throughout the country. Second, running records were kept of these stocks and these records placed under the control of one executive—the production manager—who is responsible for ample protection of all sales districts without overstocking. The yearly sales quota as well as current sales quotas were made known to this executive and he, with factory capacity charted and at all times before him, can translate the sales quotas into operating schedules.

As a next step, came gradually the ironing out of the irregularities between sales schedules and factory production. This came about through a better knowledge of factory capacities and better cooperation between factory and sales functions.

By this time the work had reached a stage where there was the organization for control and there was a method for securing facts and for setting standards.

But there is where too many stop. It is a half-way station where many companies find themselves today. Further analysis and a tightening of control must precede any smoothly operating budget.

Many of us fully understand the causes of irregularities between sales schedules and factory production, but those involved in their correction do not always recognize the practical significance of these causes. The way out is to carry along together the development of an organization and the perfecting of the method for the prompt and accurate reporting of all facts bearing on these irregularities and their prompt presentation in comparative form to the executive responsible.

This requires the preparation of correct statistics showing the progress of the business and the presentation of them to the management at the earliest possible moment. We prepare among other such data reports showing monthly sales for each commodity as to quantity, amount of sales and average sales price for each country, all cities of 25,000 population and over, each state and sales district. Sales quotas and budget figures prepared at the beginning of each year are made up along the same lines, and periodical comparisons are made between the budgetary plans and the results achieved.

Moreover, as previously stated, the production manager by frequent consultation with the various departmental sales managers is kept posted as to changes in plans of the sales departments, fluctuations and trends in business conditions, and so forth.

With such a wealth of information always at hand an even flow of production is easily achieved; the elimination of peaks and valleys in production results in better production and lower costs.

Today, economy of operations fully as much as quantity of production is the goal sought in most plants; in fact, the latter should be the natural concomitant of the former.

With this situation before us it should be borne in mind that production budgeting can increase profits in one way alone—that is, by lowering costs for any given set of conditions. And it can do it by cutting down production variations as far as practicable and by taking advantage of sales and financial trends as they are revealed by current and past facts.

As has already been alluded to, production-budget control should result in smaller capital investment and more frequent turnover of the capital actually invested. Production quotas are set three months ahead and material requirements are calculated; minimum and maximum requirements and reorder quantities are set on that basis. Overstocking and unexpected shortages are thus eliminated; all equipment is used to best advantage and idle machinery, the bane of all plant managers, is largely removed.

Budgeting has been referred to at times in a way to give the impression that by means of it conditions may be controlled. This is distinctly not the case as far as production budgets are concerned. It is not a device for controlling general conditions, but for controlling operations and their cost in an intelligent manner once these underlying conditions are known.

And it might as well be frankly stated that production budgeting which has not the whole-hearted backing of the management is on mighty thin ice. For it will be intelligently used only when the heads of each function of the business are in a position to cooperate under a capable, intelligent, and forward-looking management which believes that large business can no longer be run by instinct, impulse or precedent.

To regard production budgeting in any other way than as a step, and one of the last steps in a well thought out program, is not only misleading but dangerous. And the order in which you go about it in taking these steps is almost as important as the steps themselves. So is the speed with which you take them. The most common mistake is to push a program faster than the plant can absorb it.

While the various steps I have mentioned may to a degree overlap, and as concerns the main functions of the business (sales, financial, production) may even be taken in parallel, the safest plan and the one most likely to give lasting results is to give attention to the controls in this order: first, organization; second, general accounting control; third, sales control, and then production control.

This may sound like a tremendous amount of foundation work upon which to build the structure of production-budgeting, but without such a foundation production-control budgets can easily become little better than the spectacular stunts to which I referred.

In the long run such stunts do infinitely more harm than good, even when temporarily successful in a particular installation, for they invariably lead, among other things, to a heavy oversystematization. And incomplete results are almost sure to follow any attempt to install production-control methods without the proper foundation work.

Furthermore, unless thorough groundwork is done so as to reduce to a minimum the irregularities of production and so as to understand fully the incidents and causes of unavoidable production irregularities, you are not going to hit very close to the mark. And this very fact is going to make the setting of budgets a source of discouragement and confusion as soon as the impossibility of attainment looms up. After an experience or two of that sort many plants have become discouraged at the task. In budgeting as in most other worth-while things of life, keeping at it will produce results.

—A. J. Lansing in *Factory and Industrial Management*, January, 1928.

EXIT THE DUSTY SHELF

THE old-fashioned virtue of neatness finds an important place in industrial life. Greater efficiency results from having a place for everything and everything in its place, inventories are more correctly taken, personal hazards are reduced, and general appearances are improved immeasurably.

In machine shops, for instance, it is necessary to provide convenient storage for dogs and holding fixtures that are in constant use. Instead of keeping them in the tool-room it is desirable to

Planer-bolts and U-clamps are readily accessible hung on a wall-rack.

have them close at hand, although the "open stock" method often results in a divided responsibility that invites loss and confusion.

The bolts and clamps used upon planers, boring machines and so on, are parts that are seldom kept under the check system because they are so frequently required. Instead, they are usually kept in cupboards or on shelves as near to the machines as possible. The serious objection to shelf-storage is that only the parts on top or in

front are visible. To get at the others a man must paw over the entire lot—often in a poor light—and handle perhaps a dozen pieces before he finds the right one.

An excellent method of keeping planer-bolts and U-clamps is followed by one shop. In place of shelves, they have one wall-rack for the department of five machines, and there they keep their entire stock of bolts and clamps. Each bolt or clamp is visible at all times and may be picked out without disturbing the others.

A series of cast-iron brackets screwed to a wall-board provide 15 long slots, open at one end. At the right-hand side are kept the short bolts; at the left, the long ones. Between these extremes, the lengths are stepped down.

Their method of hanging U-clamps is interesting. Two lengths of steel are bent to stand out from the wall, forming rails that extend horizontally across the space between two windows. Over these rails the clamps are slipped. They cannot be knocked off. Each one may be lifted out without disturbing the others, each piece is visible at a glance—no overhauling a pile to find a clamp of desired length or thickness.

Quite often U-clamps are hung on nails driven into the wall or into posts. Thus hung, they are constantly being knocked down and cannot be located when most needed. Not only that, but the nails have little strength and equally small capacity for storage. They are makeshifts at best, and do not in any sense of the word offer a practical way out of a very real difficulty.

On the contrary, the method described is one of the best competitors of the dusty shelf and the rusty nail that has yet been devised—a practical solution to a trying housekeeping problem of the machine shop.

ARE WE OVERDOING INVENTORY CONTROL?

IN THE last six years industry has learned to control its inventories to a degree not before thought possible. Inventory investment is watched closely in corporations that previously gave little attention to it. And by careful scheduling of purchases and production many inventories have been stripped to the bone. Commercial establishments, too, have cut inventories, and the age of hand-to-mouth buying has come about so rapidly that many manufacturers are bewildered by the problems it presents.

Is such close inventory control an unmixed blessing?

The question is raised by Fayette R. Plumb, president, Fayette R. Plumb, Incorporated:

"I believe sales possibilities are changing and that there is danger of placing undue emphasis on cost cutting and minimum inventory. We see many instances where sales are lost because wants cannot be satisfied from minimum stocks."

George M. Verity, president, American Rolling Mill Company, also brings up this phase of hand-to-mouth buying.

"Inventory control is important," he says, "but it can be overdone, and as a result demands are made on the supplier to do things that upset all efficiency. Emergency orders are expensive where material has to be made. It is a matter to be very wisely handled."

And a particularly serious charge is made by L. J. Belnap, president, Worthington Pump and Machinery Corporation. Mr. Belnap says:

"Although hand-to-mouth buying may be with us permanently, if carried to extremes it necessitates manufacturers' inventory increase. This particularly applies to bulky products sold at a high unit price. If hand-to-mouth buying increases, it is going to have a tendency to restrict far-sightedness and vision on the part of consumers, particularly those who should give ample time for designing, laying out, and planning of projected improvements, which eventually may increase the cost and decrease the efficiency."

Factory is glad to be able to publish these three challenges to industry's present enthusiasm for close control of inventories. Precisely because hand-to-mouth buying has proved itself to be of such value as an industrial stabilizer, it would be a tremendous mistake if any evils connected with it should be permitted, through inattention, to grow and perhaps nullify the gains it has brought.

But the reader cannot fairly judge the worth of these three cautionary statements without having in mind the underlying significance of today's emphasis on inventory control. And this significance has been stated for this issue, with unusual clarity, by W. W. Galbreath, president, Youngstown Pressed Steel Company:

"It seems to me that a great deal of 'back lash' has been taken up in business during the past 10 years. Time was when manufacturer and retailer alike bought by the season. The so-called 'hand-to-mouth' buying means that we are turning in a smaller circle.

"Years ago manufacturers were content to float on a long business swing. Today it is imperative that every manufacturer move, not alone with the long curves, but follow the weekly and monthly fluctuations of his own field.

"Inventories, therefore, must be held in absolute control, else the profit on the short turns will be wiped out by the loss on obsolete inventories."

—An Editorial in *Factory,* January, 1927.

ODD-SIZED PATTERNS STORED NUMERICALLY

STEEL shelving, punched to receive dowel pins, makes it possible for the American Laundry Machinery Company, Rochester, New York, to store plate patterns in numerical series in its new pattern storage building.

The dowel pins can be readily shifted to accommodate patterns of various thicknesses, and keep the patterns upright, in an easily indexed and easily located sequence.

SIMPLE SCHEDULE SORTING

IN ANY kind of production-control system it is frequently necessary to change the schedules on different types or models. This change must be distributed to the schedules of all the parts affected, which requires a consultation of part lists and lengthy computations. By the use of pads containing small sheets like those illustrated, all this work is reduced to the punching of two holes.

There is a pad for each type or model, and a sheet for each part. The progression of numbers in the lower half of the sheet are all multiples, in fives or tens, of the number of the particular parts used in the assembly of the designated model. The sheets for all the parts of a model are collected in one pad, held together by a rubber band or a paper-clip, with a sheet for a part used only once on top. When, for example, it is necessary to increase the model schedule by 40 a week, a hole is punched through the word ADD and a hole through the number 40 of the top sheet. The second punch takes care of the proper multiples on the rest of the sheets, and the breakdown of the model into parts is accomplished.

Where the schedules of several models have been changed, the models having interchangeable parts, the sheets representing the part in the several models are collected after the changes have been punched through the pads, and the total is thus known.

The same method can be applied to ordering a number of parts for the assembly of a definite number of particular models, when these parts must be drawn from a storeroom for finished parts. The sheet can then, countersigned, act as a requisition on the storekeeper.

1

ADD TO / SUBTRACT FROM ________ SCHEDULE

TYPE ____

PART ______ COVER ____

5	10	15	20	25	30	35	40	45	50
55	60	65	70	75	80	85	90	95	100
105	110	115	120	125	130	135	140	145	150
155	160	165	170	175	180	185	190	195	200

2

ADD TO / SUBTRACT FROM ________ SCHEDULE

TYPE ____

PART ______ LUG ______

10	20	30	40	50	60	70	80	90	100
100	120	130	140	150	160	170	180	190	200
210	220	230	240	250	260	270	280	290	300
310	320	330	340	350	360	370	380	390	400

When the model schedule is changed, two punches take care of the breakdown of the model into parts.

TOOL LOSSES ARE EASILY CONTROLLED

A PLANT having several tool-rooms made a study of the methods used to check tool losses in an effort to settle on the best procedure.

The first method investigated involves the use of a card receipt

bearing the description of the tool. The receipt is filed alphabetically or numerically, according to the tool. A single large blank can be used for one tool and a series of signatures. This may be called the "receipt method."

The single-check method was next considered. The stock-room keeps a board with rows of hooks on it, each hook representing by number an employee. Brass disks represent each tool. When a man borrows a tool, its brass check is hung on the hook corresponding to the man's number. The number of disks on the hook tells how many tools he has out, and a scrutiny of the individual checks will tell which tools he has.

The third method calls for the use of a double-check system. The stockroom has the same board of hooks and the individual tool checks. In addition, each employee is given a dozen or more brass checks with his hook number stamped on each. When a man borrows a tool, the tool check is hung on his hook. The man's check is taken, however, and is put in place of the tool—a sort of substitute for it.

The company decided to adopt the double-check system. With the receipt system it is impossible to tell, without looking through the complete file of cards, how many tools and which tools are listed against an employee. With the single-check system it is impossible to tell, when the tool is wanted or if the man is delinquent in returning it, who has the tool without looking through the stack of checks on each employee's hook.

But with the double-check system a glance at the board of hooks will tell how many and which tools the man has in his possession. A glance at the crib or box or other tool receptacle will tell which man has the particular tool sought.

The men must return their checks or have a signed release from the tool storekeeper before they receive their final pay on leaving the company.

SHOP BOXES FORM PART OF PRODUCTION PLAN

AT THE Remington Cash Register Works of the Remington Arms Company, Ilion, New York, thousands of steel shop-boxes are used to transport parts and material from one job to another. They form an integral part of the production plan and are quite as important to the system as the screw-machines, punch-presses, and other tools and machinery.

Three standard sizes are in use, the largest having four times the capacity of the smallest, and the intermediate size twice the capacity of the smallest. The largest box is strong enough to carry 125 pounds of parts or material without distortion, and the smaller boxes in proportion. The boxes stack interchangeably. A pocket for the production card is attached to the side of the box, giving full protection to the card and at the same time making it easy to remove it without disturbing a pile of boxes. The taper on the sides of the boxes is sufficient to protect the card pockets from damage when two boxes are bumped together.

Brass number-plates attached to the upper edges above the handle at each end permit the routing of boxes through the plant, and by looking at production records the exact location of a certain box of parts can be determined at any time.

FILING SPEED INCREASED 25%

A TIME-SAVING method of filing blue-prints and tracings has been adopted at the Western Electric Company, Chicago. Each filing cabinet is really built around the folders which form the unit of the plan. The folder is merely a press-board back with rounded front corners. At the back edge is stitched a canvas cover. The press-board forms the foundation upon which the prints or tracings are placed and the canvas sheet makes the cover. What may be overlooked, however, is the ingenious function the cabinet plays in addition to the mere holding of the folders.

The wooden partitions in the cabinet are tapered thin at the front edge. This provides a larger opening at the very front than exists over the rest of the area. The effect is that in pushing in a filled folder the drawings are compressed and "ironed" flat. Hand "holes" are cut out at the front of the wooden separator strips to allow a good grip in removing the folders.

The cabinets are made up with 40 filing spaces which brings the top five feet above the floor. Every ten compartments there is a sliding shelf so that folders do not have to be handled any distance to be opened.

When the drawings have to be consulted frequently, 50 has been found to be a convenient number to be filed in each folder, but where they are used merely for storage any number up to 125 is feasible.

The partitions of this filing cabinet are tapered thin at the front edge. When the folders are pushed in, the drawings are "ironed" flat.

Filing speed has been increased about 25% since this method has been adopted. Moreover, the fire risk is considerably lessened with tightly pressed piles as compared with loose collections of drawings. Then light, air, and dust are excluded under this method. Since the canvas is substantially water-proof and since the tracings do not come to the edge of the folder, there is little likelihood of the water penetrating should a sprinkler head happen to let go.

STOCK CONTROL THAT TIES-UP WITH SALES

A YEAR or two ago the Morse Twist Drill and Machine Company of New Bedford, Massachusetts, was confronted with the problem of installing a new stock-control system which would better serve its many customers, and at the same time reduce the amount invested in goods which did not move. The system used previous to that time did not keep in close enough touch with sales to control and check the manufacture of goods when sales were slow, or to speed up production and keep pace with the sales where goods

were moving rapidly. This resulted in over-stocks on some items, while on others we were just as badly under-stocked.

After considerable thought and some experiment, the plan described in the following paragraphs was put into use and has worked out to our entire satisfaction.

A schedule representing average sales for a period of months is drawn up. This schedule shows separately every size and style of goods regularly carried in stock. Half of this is devoted to finished goods and is regarded as the absolute minimum to which our stock is allowed to fall.

Goods on hand mean nothing and will soon become exhausted unless backed up by goods in process, and here is where the remaining portion of the schedule is found—goods in process of manufacture. The sum of completed goods in stock and incomplete goods in the shop, approximates our average sales for the period. When this total stock falls below this standard, another "order to make" is placed in the shop.

The actual clerical procedure is as follows: A stock-record card of the usual type is employed and entries are made daily. Minimum quantities are set for both "stock on hand" and "on hand and in process." If, in balancing the card, the stock on hand is found to have fallen below the minimum set, a red tag is attached to the card. If the total of goods on hand plus goods in process falls below the minimum set, a blue tag is attached.

At least twice a week, or oftener if necessary, the files are gone over. On items showing blue tags, orders to make are entered on the cards and put into the shop and the blue tag is removed.

Once a week the files are looked over for red tags, and a notice is sent to the proper shop officials of such items. This notice keeps those officials informed as to the goods on which stock is getting low, and secures quick action on them. The red tag is not removed from the card, but remains attached until our stock is once more above minimum.

To maintain stock on hand at any level, it is necessary that production equal sales, and that finished goods be placed in stock as fast as withdrawn.

Under the plan outlined, things have worked out in this manner. We have on our shelves approximately the quantities planned for, and from this quantity sales are being withdrawn every day at a certain average rate. These withdrawals are being replaced by

goods from the shop at a like average rate, while still further back, goods in process are being replenished by like amounts.

By using this system we have been able to reduce our inventory considerably, since our production has been concentrated on goods we need and are using constantly. Manufacturing time has been shortened for the same reason. Manufacturing cost has been reduced because goods can be made in quantities and general investment cost has been lessened because we are removing from our stock-room, over-stock on slow sellers, and from the shop, goods that are not active and only tend to block and retard the manufacture of those that are.

QUICK ACCESS TO STORES

WHERE you have a large number of small parts to keep segregated and easy of access, you have something of a problem, particularly where storage space is limited.

This was the situation at the Lyon Metallic Manufacturing Company in connection with the storage of number plates used on steel

Metal panels which slide at right angles to the wall provide a convenient method of storing number plates used on steel lockers.

lockers. To keep them in shelf compartments along a wall would take up too much space.

The problem was met, however, by constructing metal panels which slide at right angles to the wall.

Little metal pockets are affixed to both sides of these slides and these pockets hold the name plates one above the other, face up.

The 14 slides take up but little space and yet they accommodate 2,500 different numbers, in addition to a few odd letters and special combinations of numbers and letters. No numbering or identifying system is needed as the number is always readily visible and the number plates serve to identify themselves.

IS YOUR RECEIVING SYSTEM TOO COMPLICATED?

THREE points must be kept in mind in building an efficient method of receiving goods: first, that the quality of the goods received must be known; second, that the quantity of these goods must be known; and third, that continued and efficient production often depends on the speed of handling incoming materials. The problems involved in the first two points are obvious and are covered in any plan of receiving which is successful. The third point, though is missed by many who have the idea that present methods are stable and, therefore, cannot be improved. Subject to the control of the first two requirements of receiving, every effort should be made to simplify the receiving system, in order to gain speed and flexibility.

We have first the question of the invoice. The handling of this form can generally be entirely divorced from the receiving routine, and be made a routine between the purchasing and the accounting departments alone. The assumption is that the vendor is a responsible party who will listen to any reasonable claims for error in quantity, or quality, of goods, even though the invoice has been paid. The purchasing department will, under these circumstances, approve the invoice, when in accordance with the purchase order, and give it final approval on receipt of the "received" sheet from the stores department.

Nor do the receiving and stores department need to come in contact with the purchase order. In many systems, the purchase order is used by these departments to check goods received, as to material ordered, shipping marks, and other details. When an error in in-

coming material data is found, it nevertheless becomes necessary to consult the purchasing department for confirmation of the error, before action can be taken. Therefore, it is entirely practical to pass the information about the material to the purchasing department in the first place, and to let the purchasing department do the checking.

Such a plan would perhaps require the development of a file in the stores department to take care of unclassified material. The stores department, of course, has a list of classified material carried. It is also taken for granted that the material records are cared for in some sort of a record office more closely connected with production control, or costs departments, than with the actual stores themselves. The unclassified record, however, is not always necessary where a balance-of-stores clerk is assigned the duty of releasing the goods for issue, for in such case the stores department needs to know only that the goods received are not standard, and that they, therefore, must be held in a special location until instructions are received as to disposition.

The usual plan in receiving goods is for the receiving clerk, as he counts or identifies materials, to make out a list which shows the obvious description of the material, the quantities, and other necessary information. This list must then be copied onto a "received" sheet, made out for each lot, and usually typed in from five to seven copies, with considerable delay, consequently.

If the "received" sheet can be handled in three copies only, it becomes possible to have these copies made out by the receiving department directly from the information on the goods themselves, thus furnishing an original memorandum to those departments interested which makes it possible to send these sheets to the proper places as soon as the goods are identified. If the goods are in carload lots, it may be practical to use a supplementary tally sheet to compile the necessary data. This tally sheet should, however, become a definite part of the "received" sheet.

In the form shown, tallies are made directly on the "received" sheet, thus eliminating any other form. For part shipments, the same form in half size is used.

This plan, however, calls for close cooperation among purchasing, stores-record, and stores departments, a cooperation which is not always to be obtained. There is no real reason, though, why each

of these departments should keep a record to prove its individual guilt or innocence, if charged with error by another department. If this lack of trust can be overcome, the elimination of many files for such records will save considerable work. There should be one file for the benefit of the auditor. There should be another file in the stores-record department. As it is from this latter record that the appraising is usually done and all data as to quantity obtained, the stores-record department file should probably be the master file, to which every one refers when verifying any figures. A third copy may be filed in the purchasing department. This third file is not necessary, but, seems desirable in order that the purchasing department may have a complete record of all transactions with vendors. Neither requisitioner nor stores department needs a permanent file. If there is any question about material after it has all been received and disposed of, it should be a fairly easy matter to verify information by telephoning the stores-record or purchasing departments.

Finally, when quality inspection takes place, this work should be done with a proper follow-up by stores. This means that, although certain copies of the "received" sheets may be released for the signature of the quality inspector, at least one copy must be kept by the receiving clerk to make sure that the material is quickly handled. In many systems provision is made in the regular form for the rejection of material. If, however, notations are made on the originals that such material has been rejected, the detail of the rejection report may be a separate record filled out for this purpose.

One condition must be observed in this plan, if successful. The receiving clerk himself and his assistants, if any, must not only be reliable, but must also be capable of making clear-cut and readable records of all goods received. They must be trained not to allow errors of entry which, under the old scheme, might be checked and caught in the stores office, but which in the new system will go up to the purchasing agent, with, when found, the consequent delay.

In accordance with the suggestions made, three files common in the storeroom, the invoice, purchase order, and "received" sheet files, have been discontinued. One full typewritten transcribing of the form has been replaced by a hand-written form made out as quickly as the usual "blotter." At least one checking of the form is saved by sending it direct from receiving to purchasing, thus saving several hours of time and clerical cost. Finally, the authority

is concentrated, the functions are clear-cut, and the records are kept at controllable points.

Many of the details of such a plan, such as equipment for receiving clerks, variety of receiving forms, type of messenger and telephone contacts, must be worked out in the particular organization, but if these essential points are followed, no difficulty should be found in disposing of the details.

—John A. Fisher in *Factory*, July, 1927.